US010000264B2

(12) **United States Patent**
Sheard

(10) **Patent No.: US 10,000,264 B2**
(45) **Date of Patent: Jun. 19, 2018**

(54) **UNDERWATER WATERCRAFT**

(71) Applicant: **Ian Sheard**, Upland, CA (US)

(72) Inventor: **Ian Sheard**, Upland, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days. days.

(21) Appl. No.: **15/021,931**

(22) PCT Filed: **Sep. 3, 2014**

(86) PCT No.: **PCT/US2014/053903**
§ 371 (c)(1),
(2) Date: **Mar. 14, 2016**

(87) PCT Pub. No.: **WO2015/038384**
PCT Pub. Date: **Mar. 19, 2015**

(65) **Prior Publication Data**

US 2016/0229503 A1 Aug. 11, 2016

Related U.S. Application Data

(60) Provisional application No. 61/877,282, filed on Sep. 12, 2013, provisional application No. 61/937,230, filed on Feb. 7, 2014.

(51) **Int. Cl.**

B63G 8/22	(2006.01)
B63G 8/00	(2006.01)
B63G 8/04	(2006.01)
B63G 8/38	(2006.01)
B63H 5/125	(2006.01)

(52) **U.S. Cl.**
CPC ***B63G 8/22*** (2013.01); ***B63G 8/001*** (2013.01); ***B63G 8/04*** (2013.01); ***B63G 8/38*** (2013.01); *B63B 2211/02* (2013.01); *B63H 2005/1258* (2013.01)

(58) **Field of Classification Search**
CPC . B63G 8/00; B63G 8/001; B63G 8/04; B63G 8/14; B63G 8/16; B63G 8/18; B63G 8/22; B63C 11/46
USPC 114/312, 330, 331, 332
See application file for complete search history.

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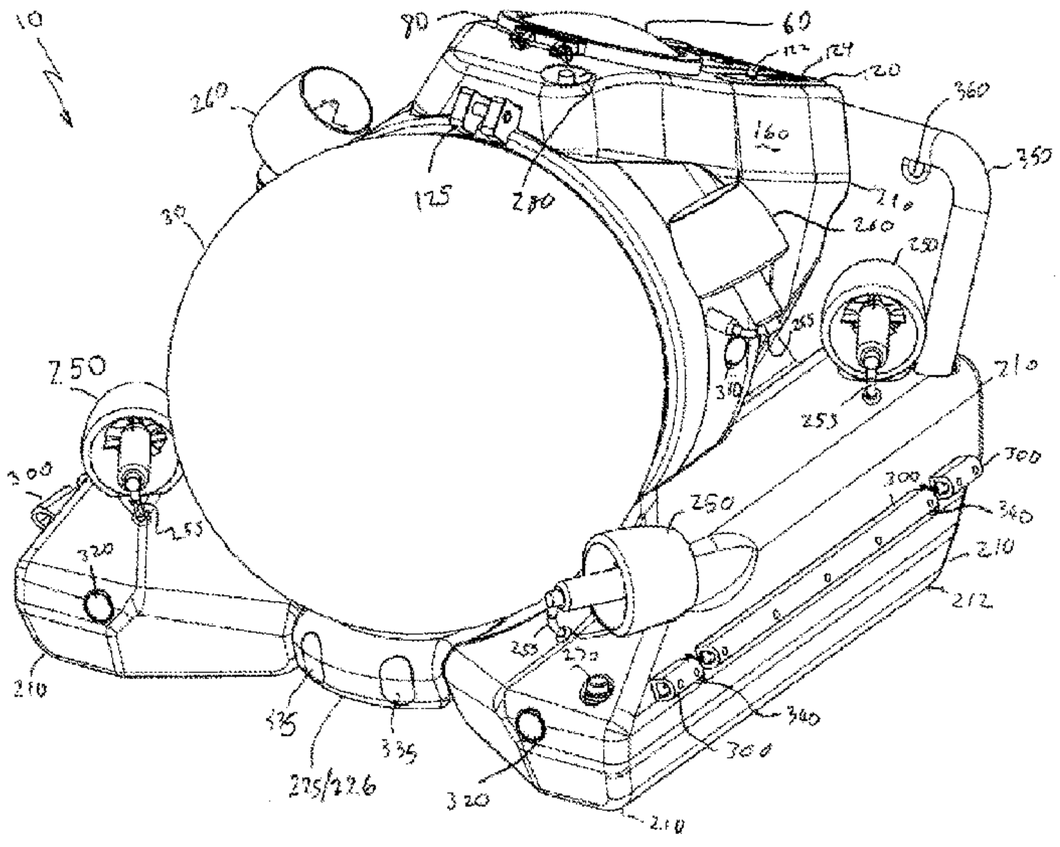
(Continued)

Primary Examiner — Lars A Olson
(74) *Attorney, Agent, or Firm* — Brook Law Group, P.C.

(57) **ABSTRACT**

An underwater watercraft including a passenger compartment and an ingress egress port in which the watercraft has buoyancy and center of gravity adjusted to maintain a generally level or other desired attitude when submerged, and an angled attitude at a water surface for ingress/egress. The attitude also is adjustable via the placement of ballast and optionally including a movable ballast that adjusts the location of the center of gravity as desired. The ingress-egress port optionally includes an entry elevated from a main passenger compartment, that has an angled orientation in a submerged mode, and an optional orientation generally parallel to the water surface in a surface mode.

20 Claims, 28 Drawing Sheets



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2014/0090590	A1 *	4/2014	Maurer	B63G 8/18 114/330

* cited by examiner

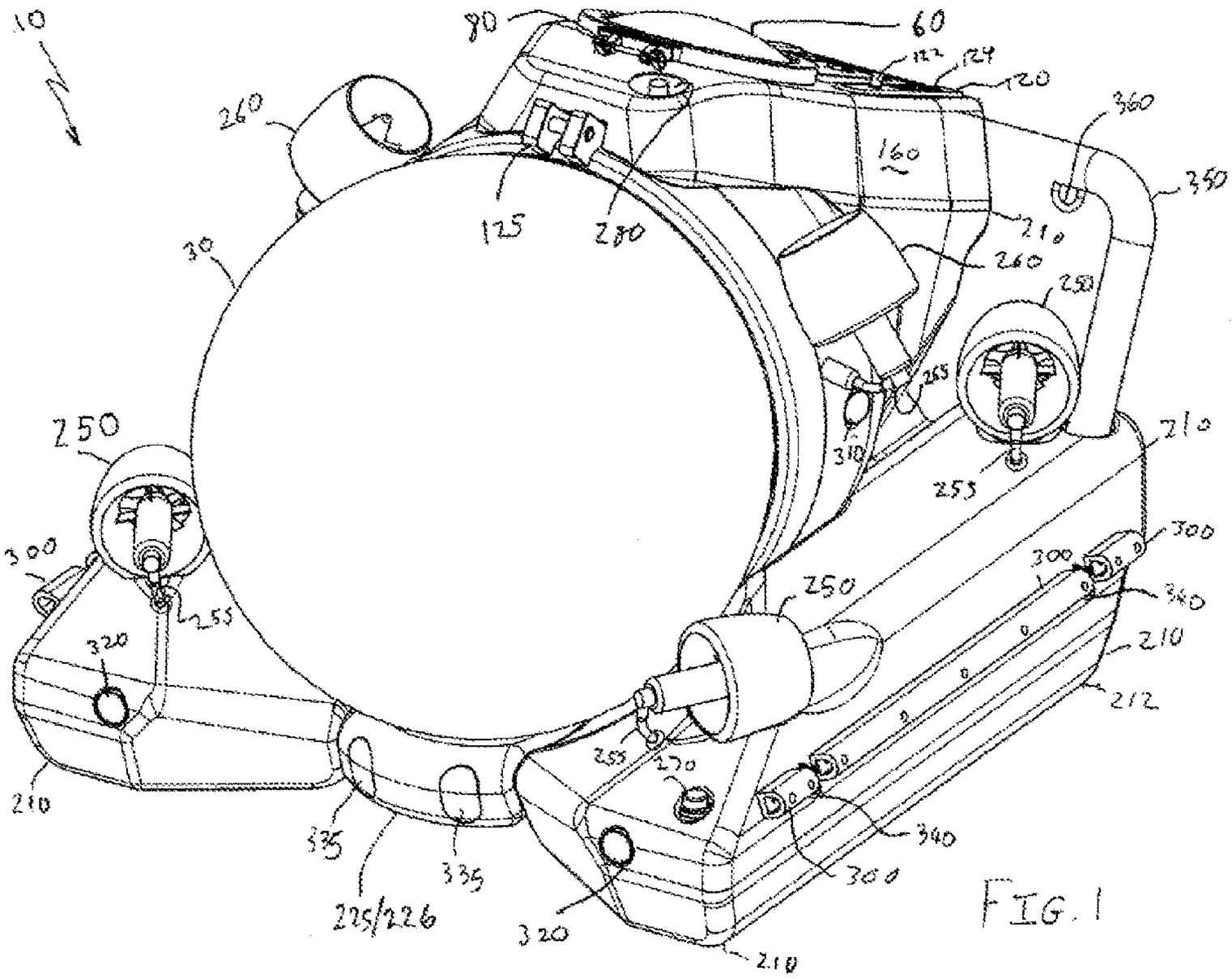
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FIG. 1

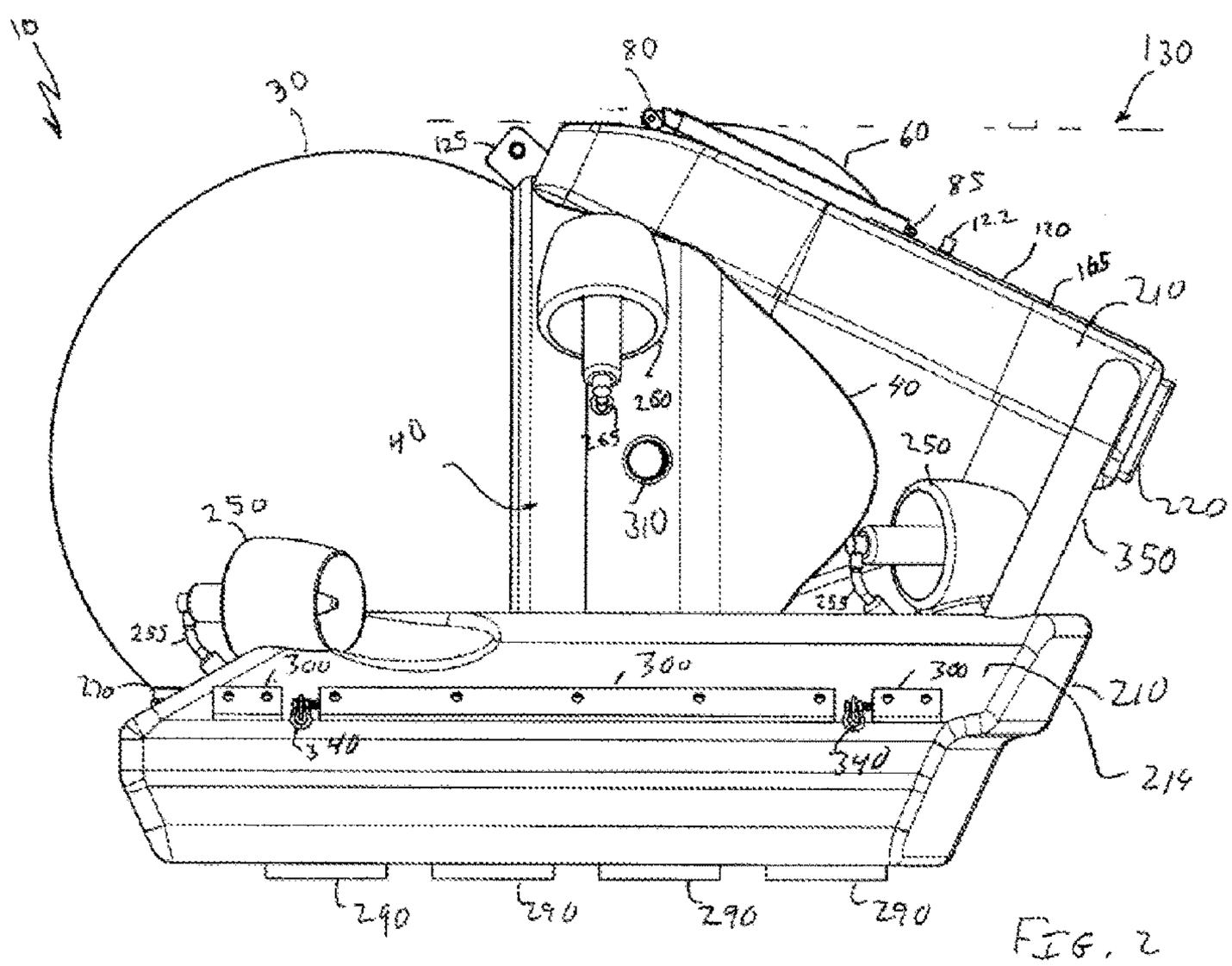
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FIG. 2

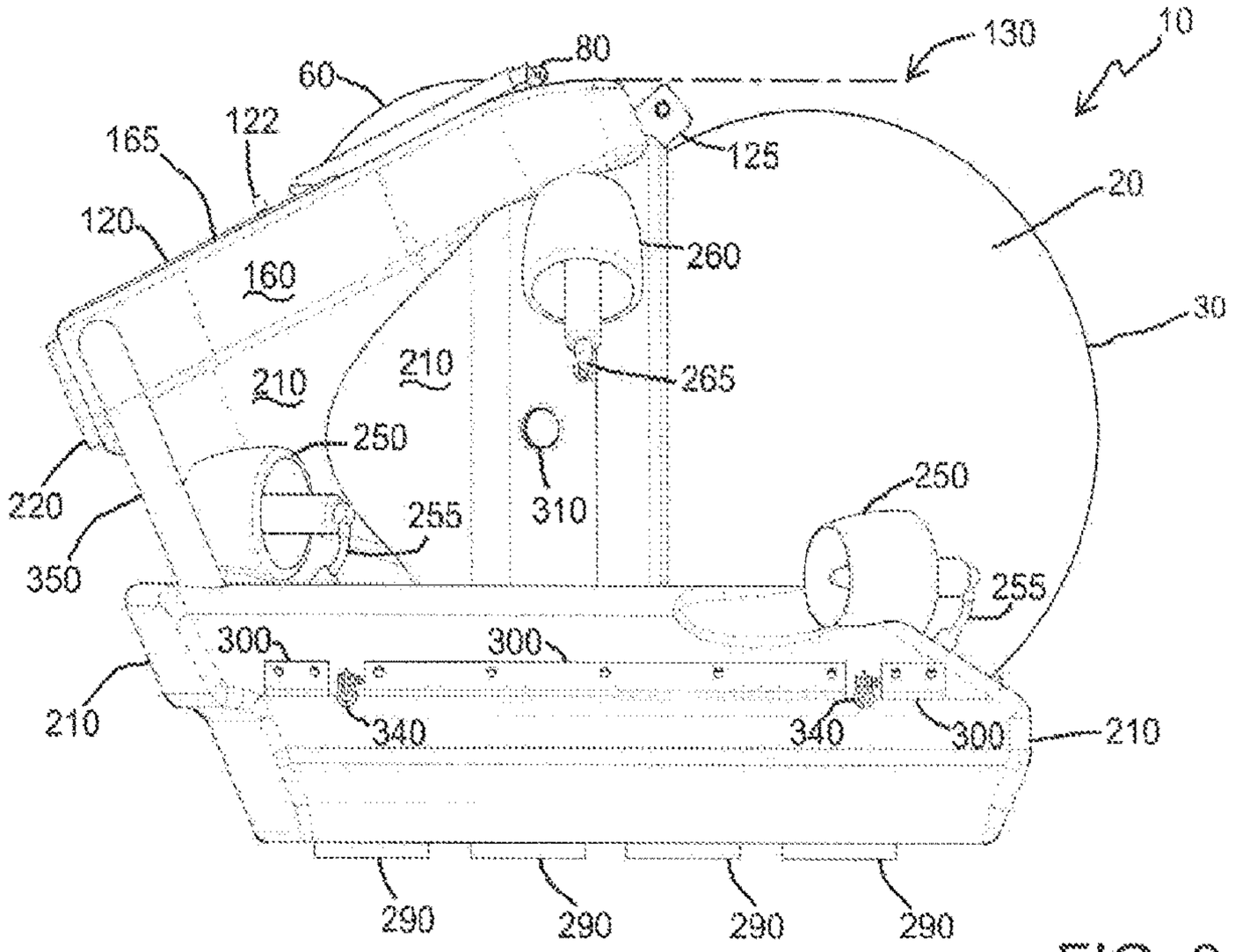
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FIG. 3

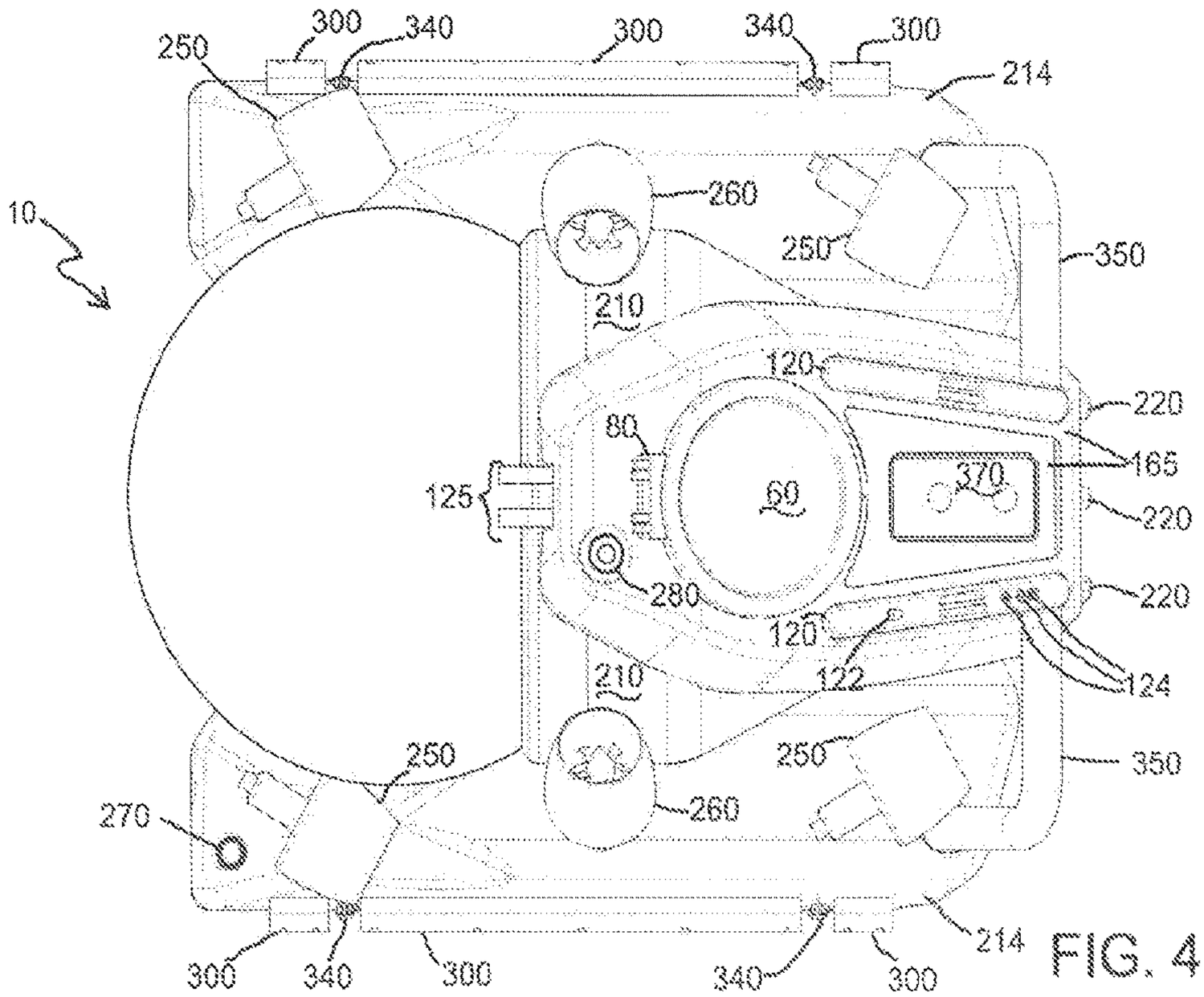
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FIG. 4

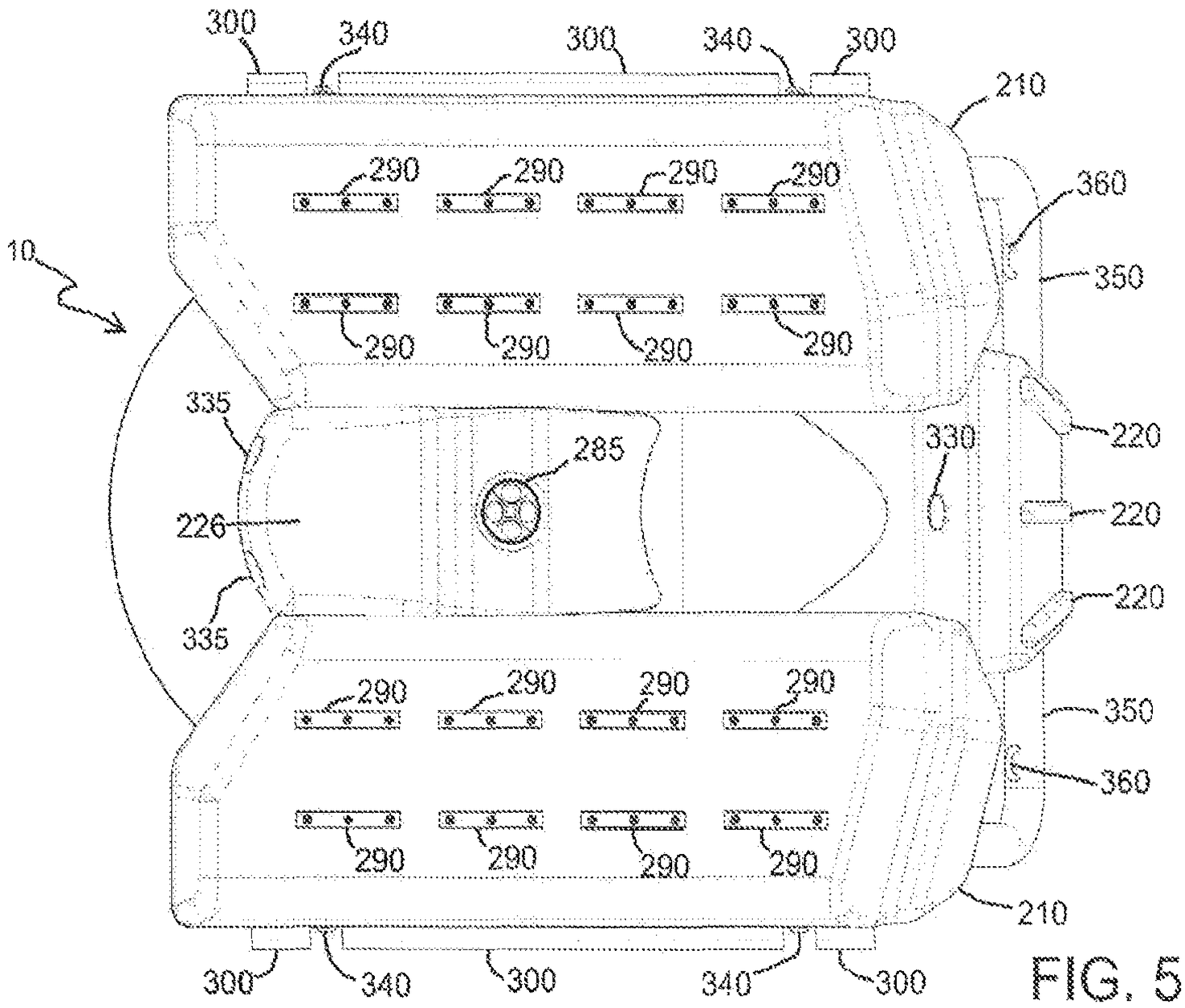
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FIG. 5

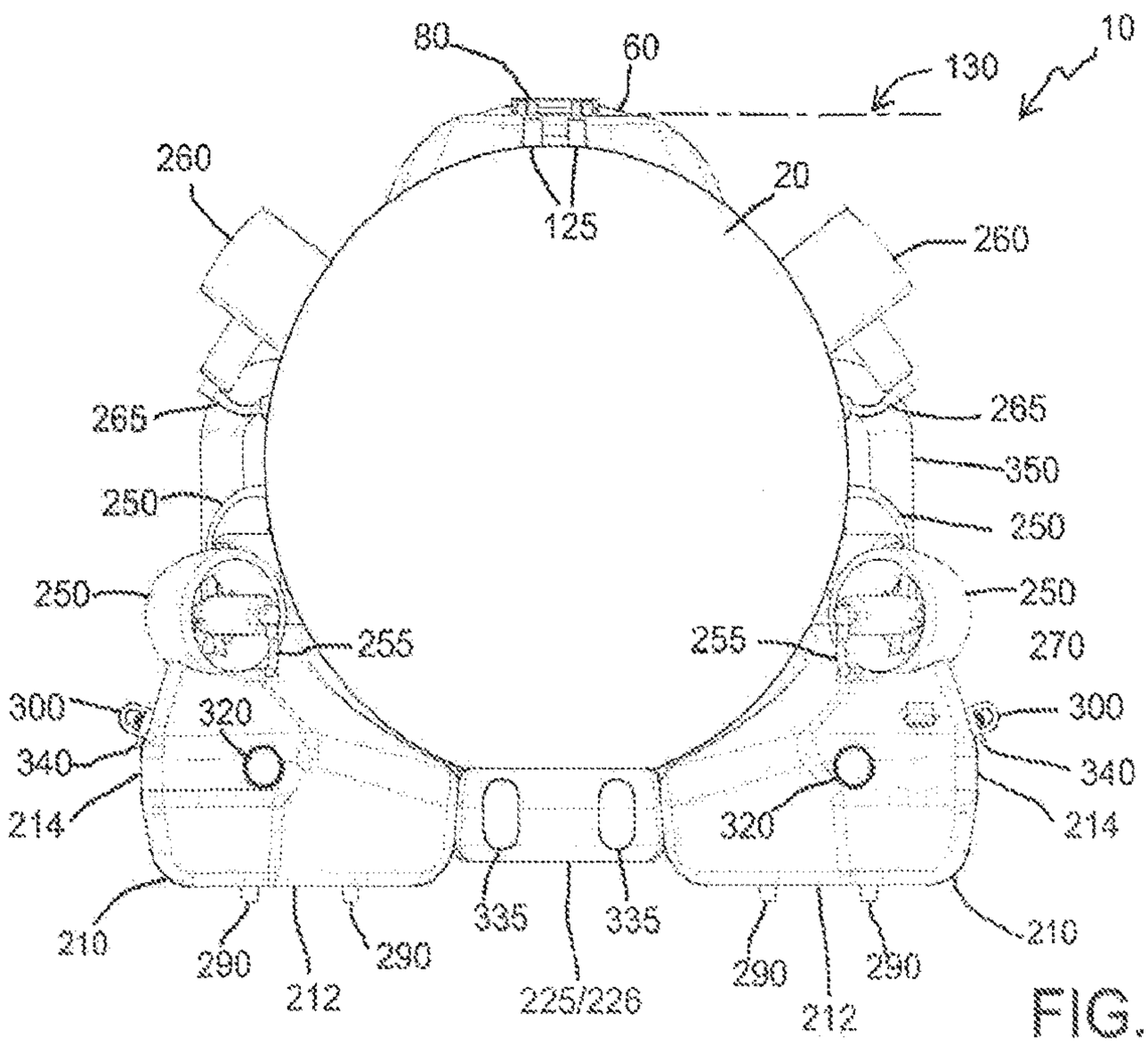
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FIG. 6

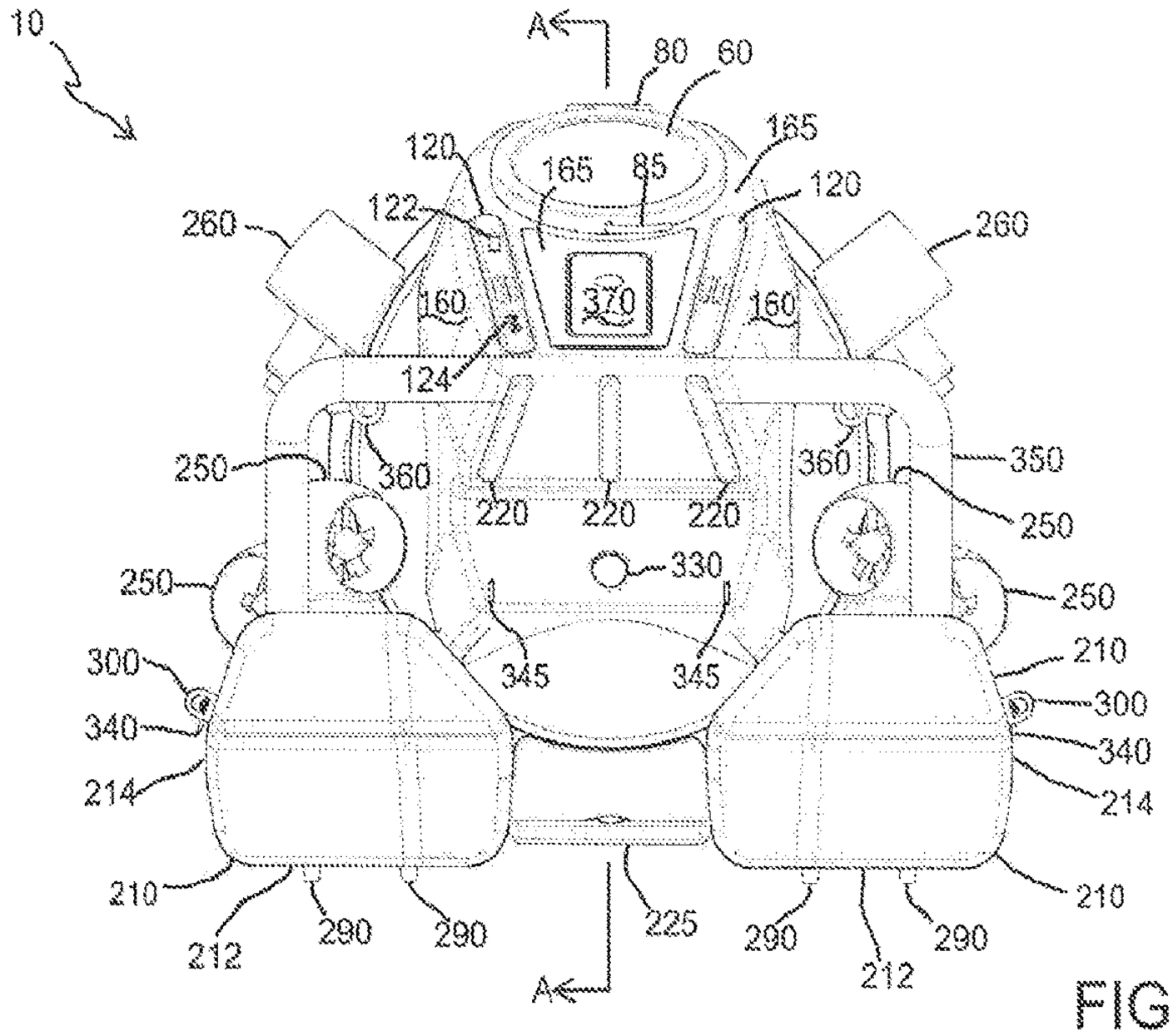
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FIG. 7

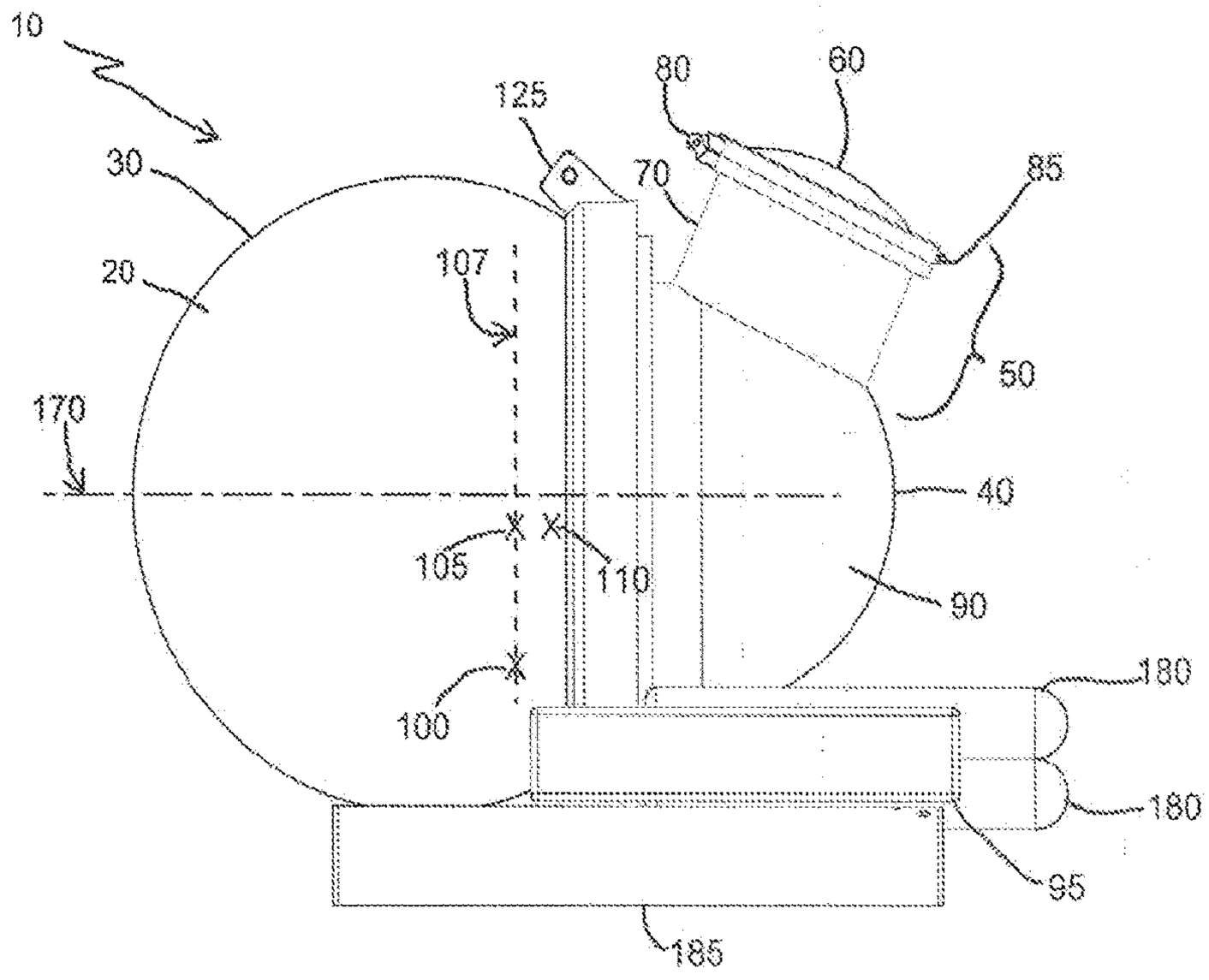
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FIG. 8

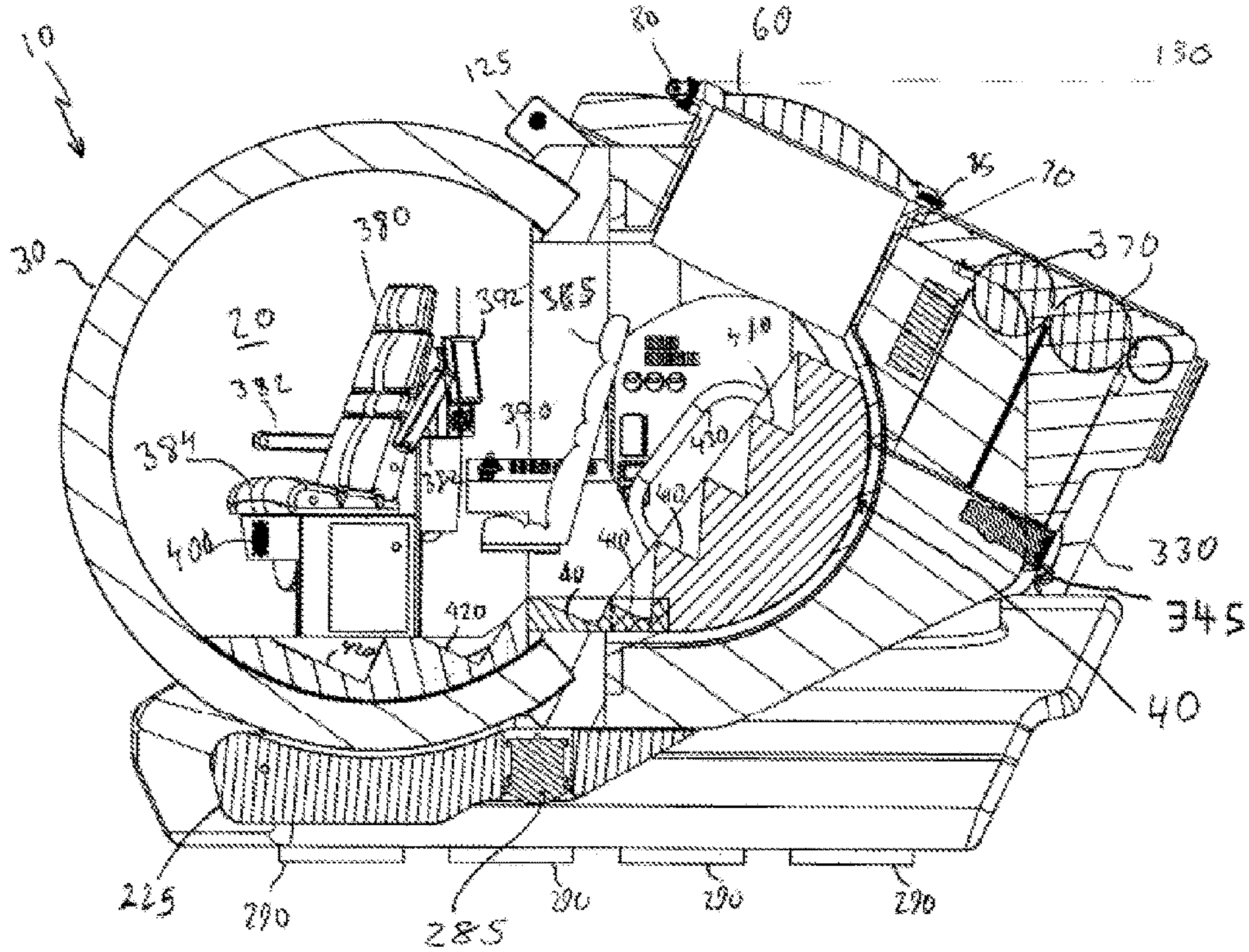
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FIG. 9

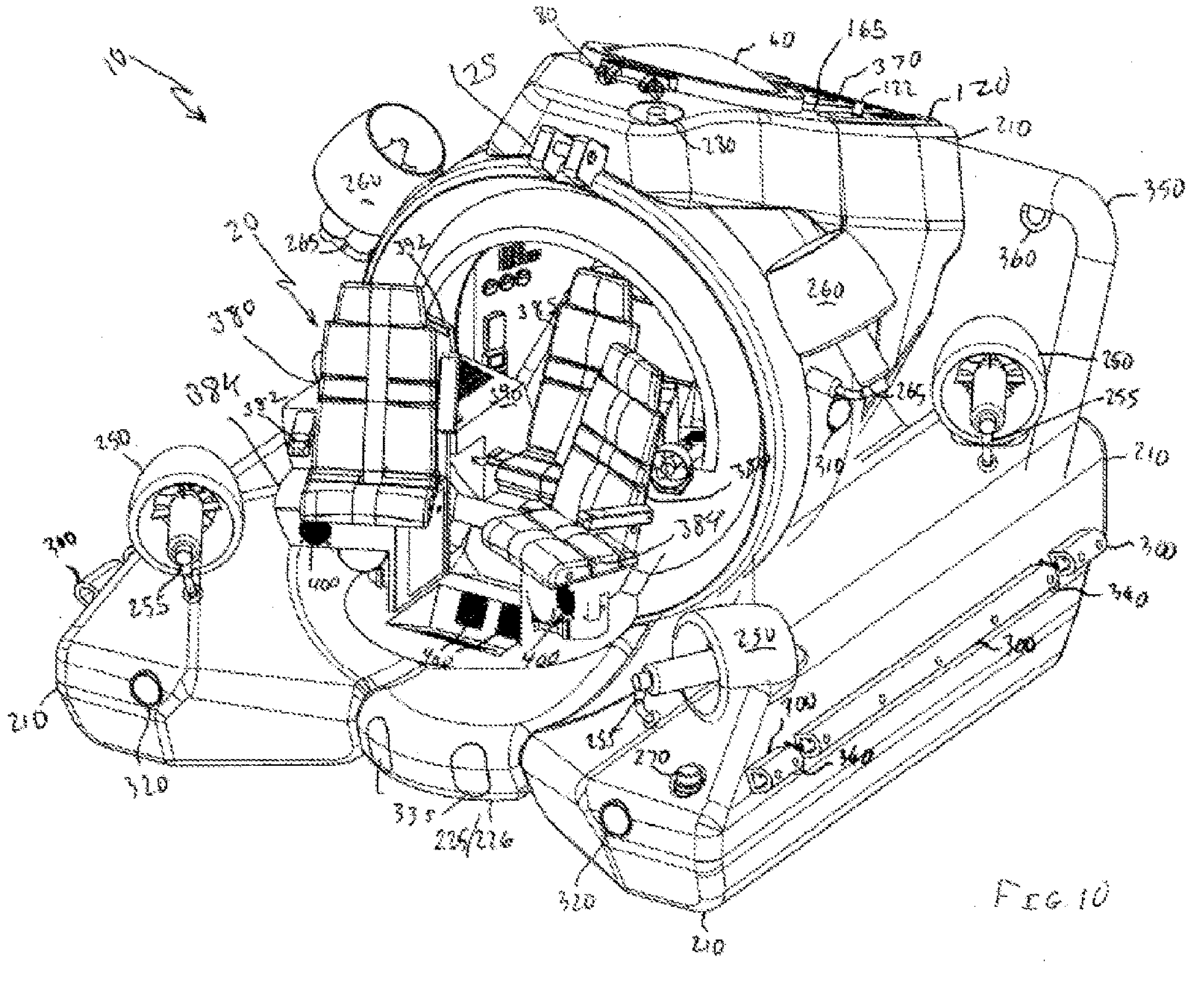
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FIG. 10

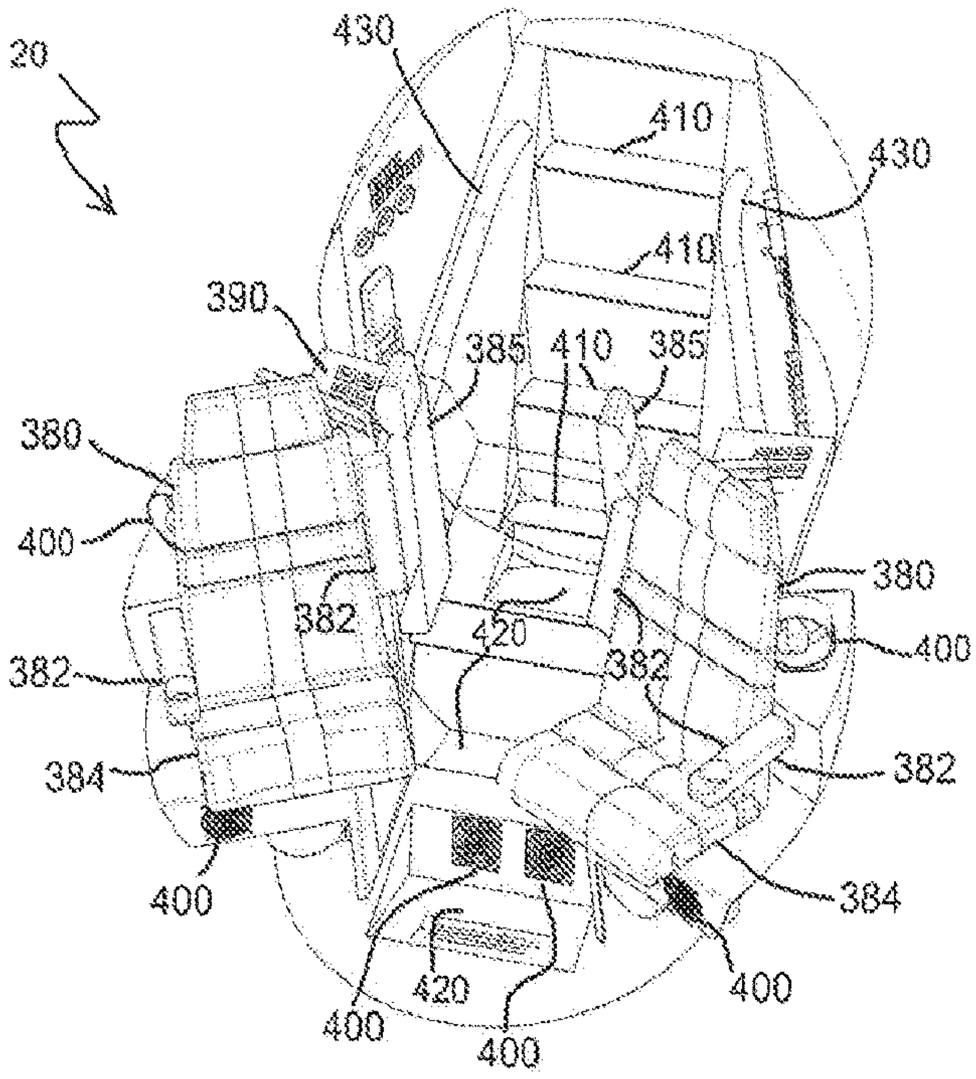
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FIG. 11

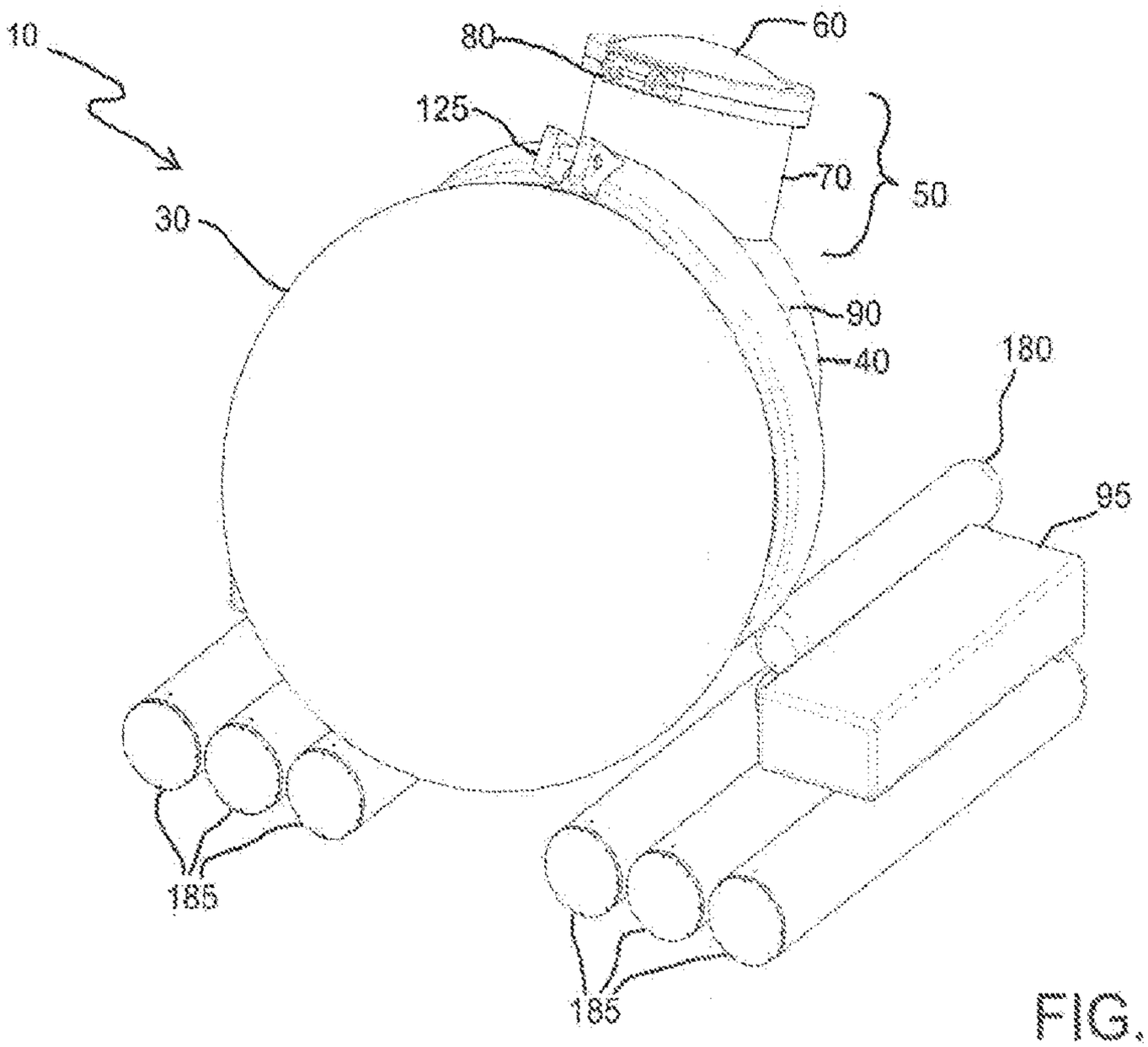
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FIG. 12

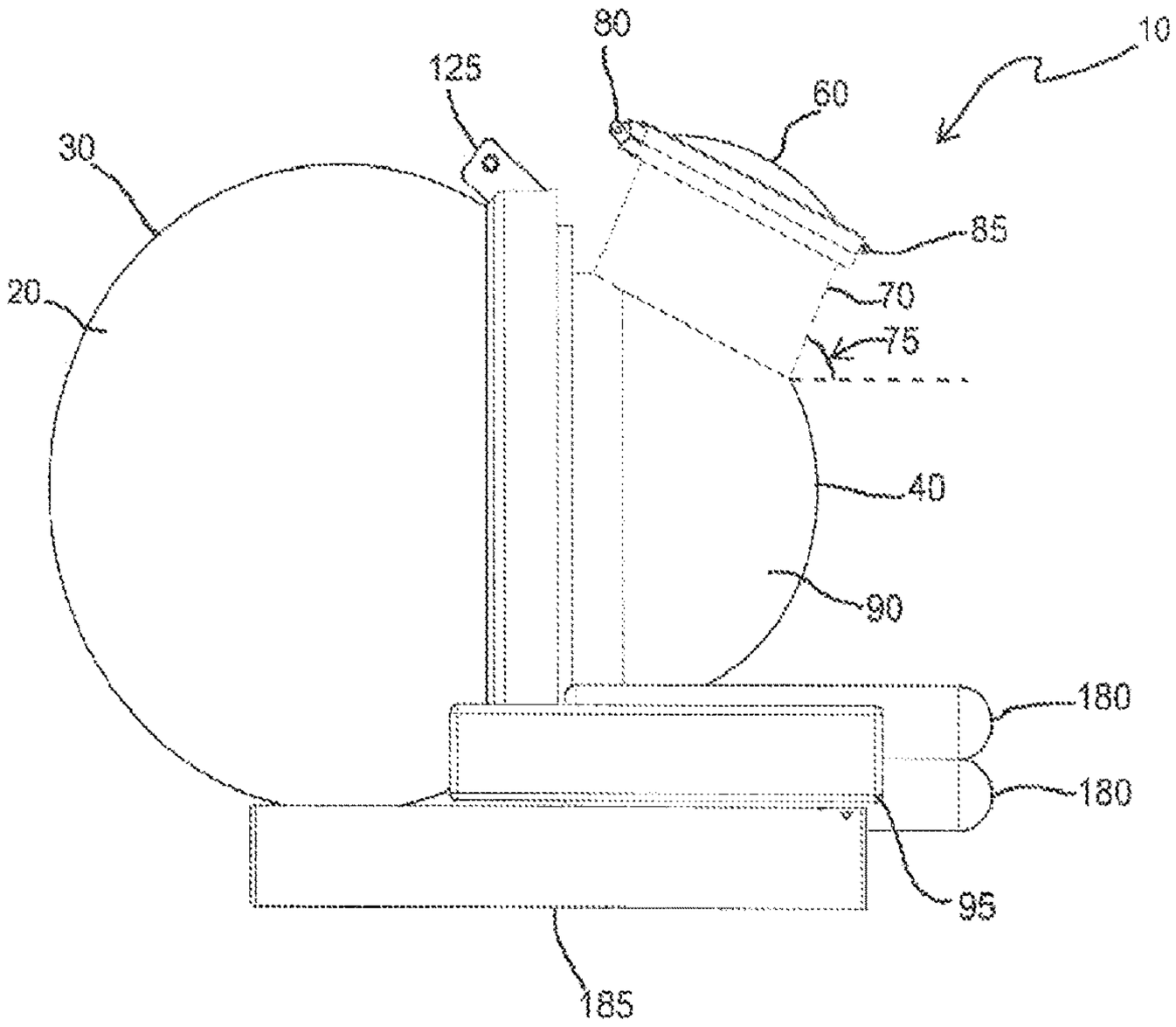
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FIG. 13

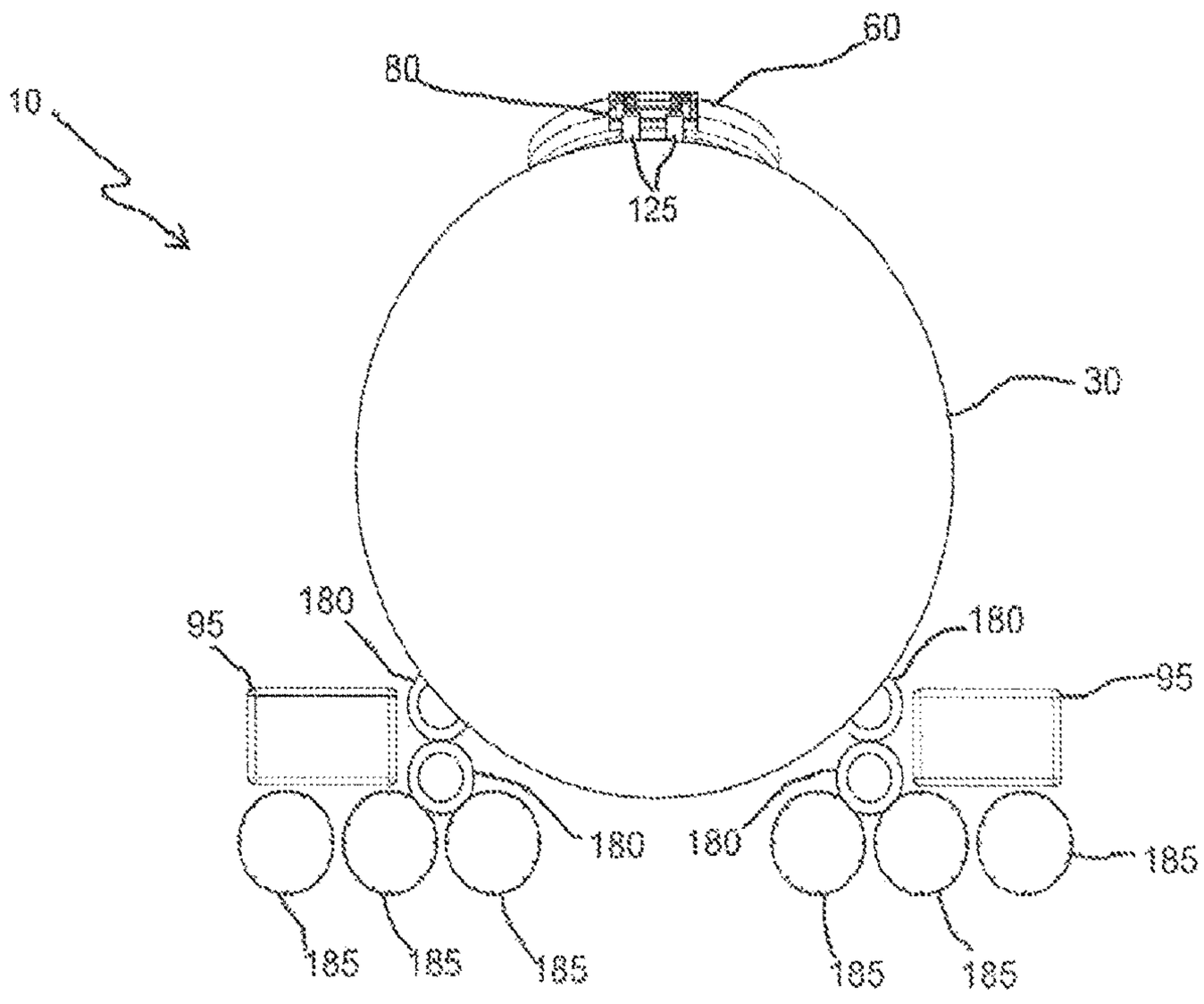
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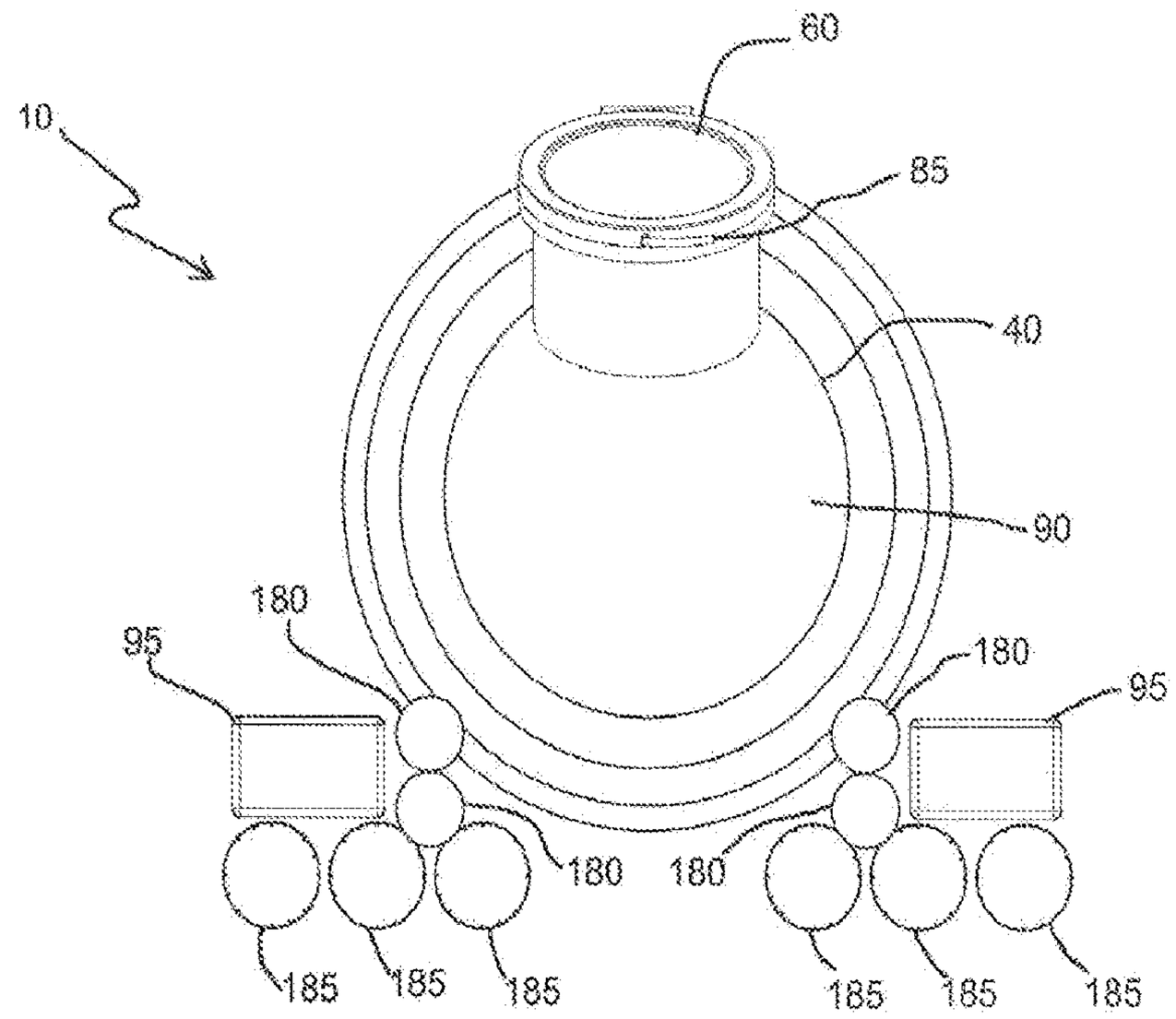
FIG. 14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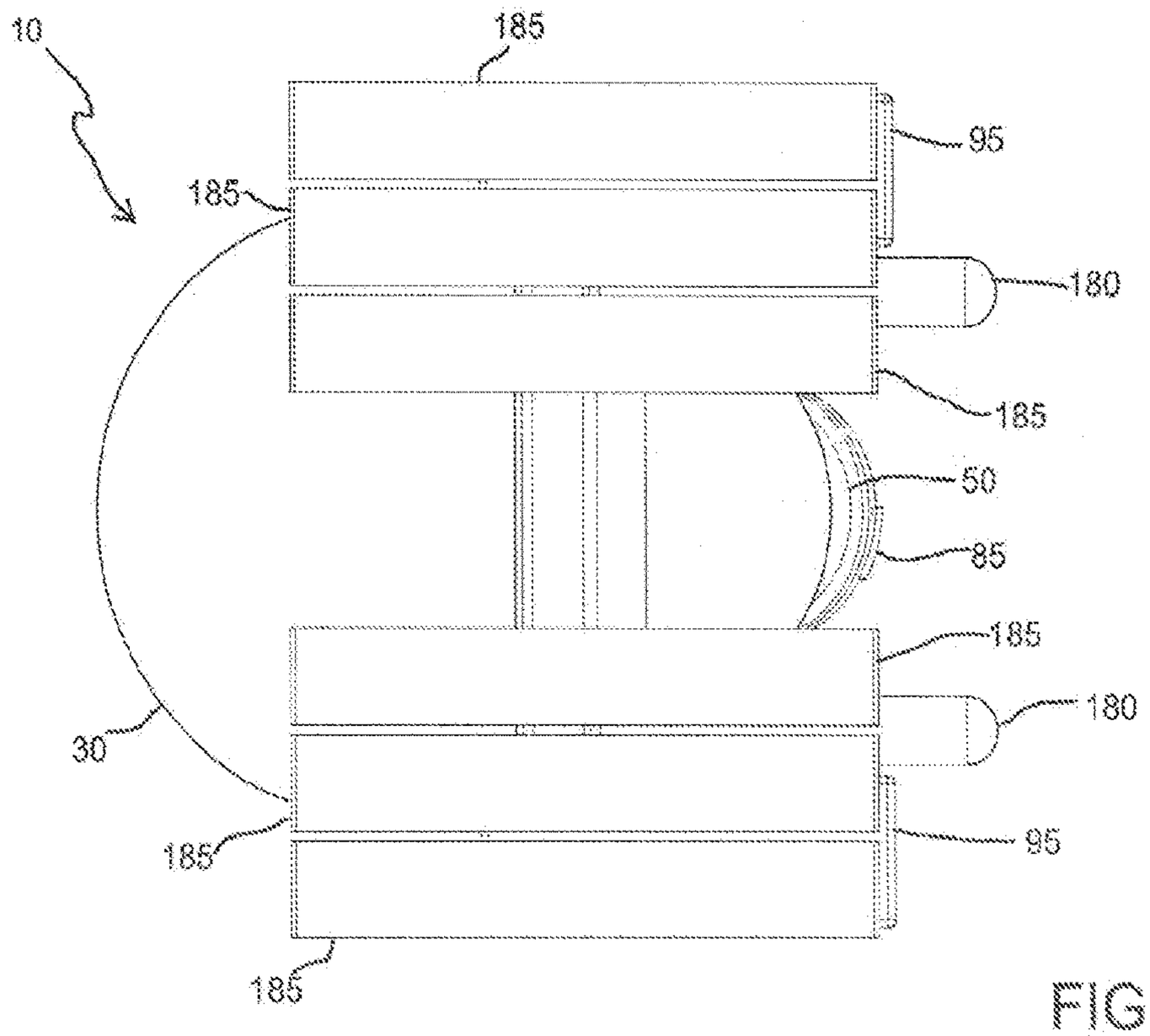
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FIG. 16

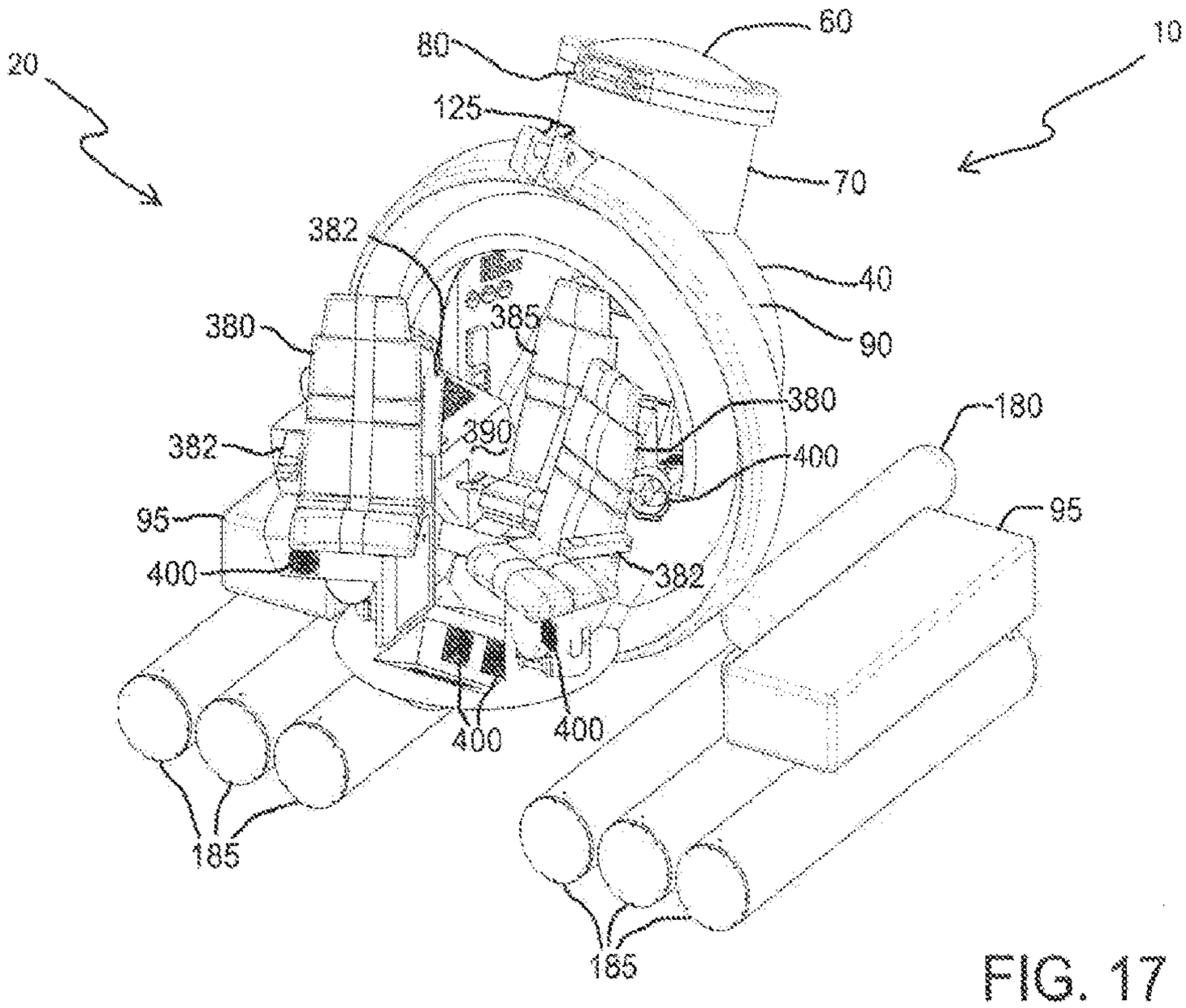
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FIG. 17

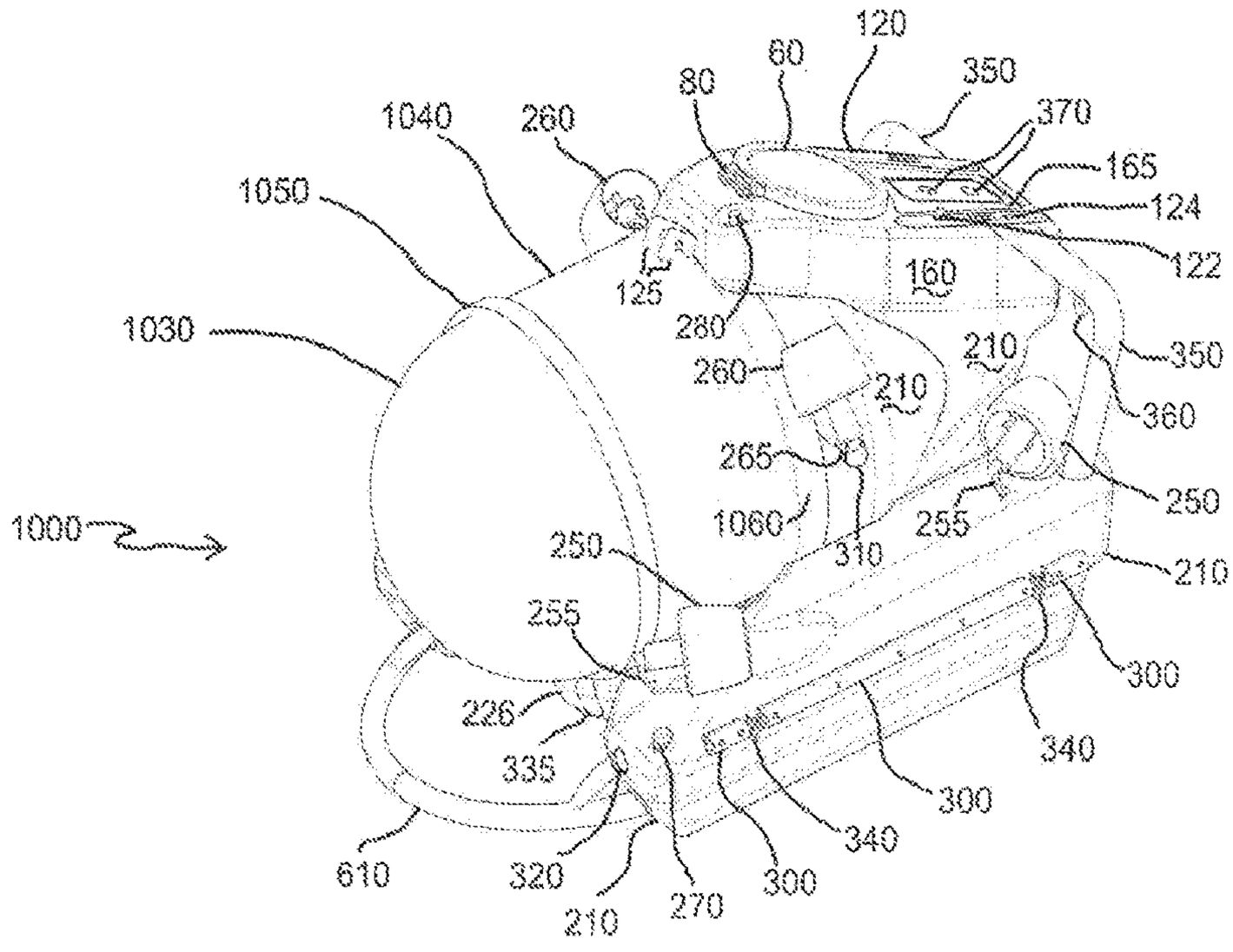
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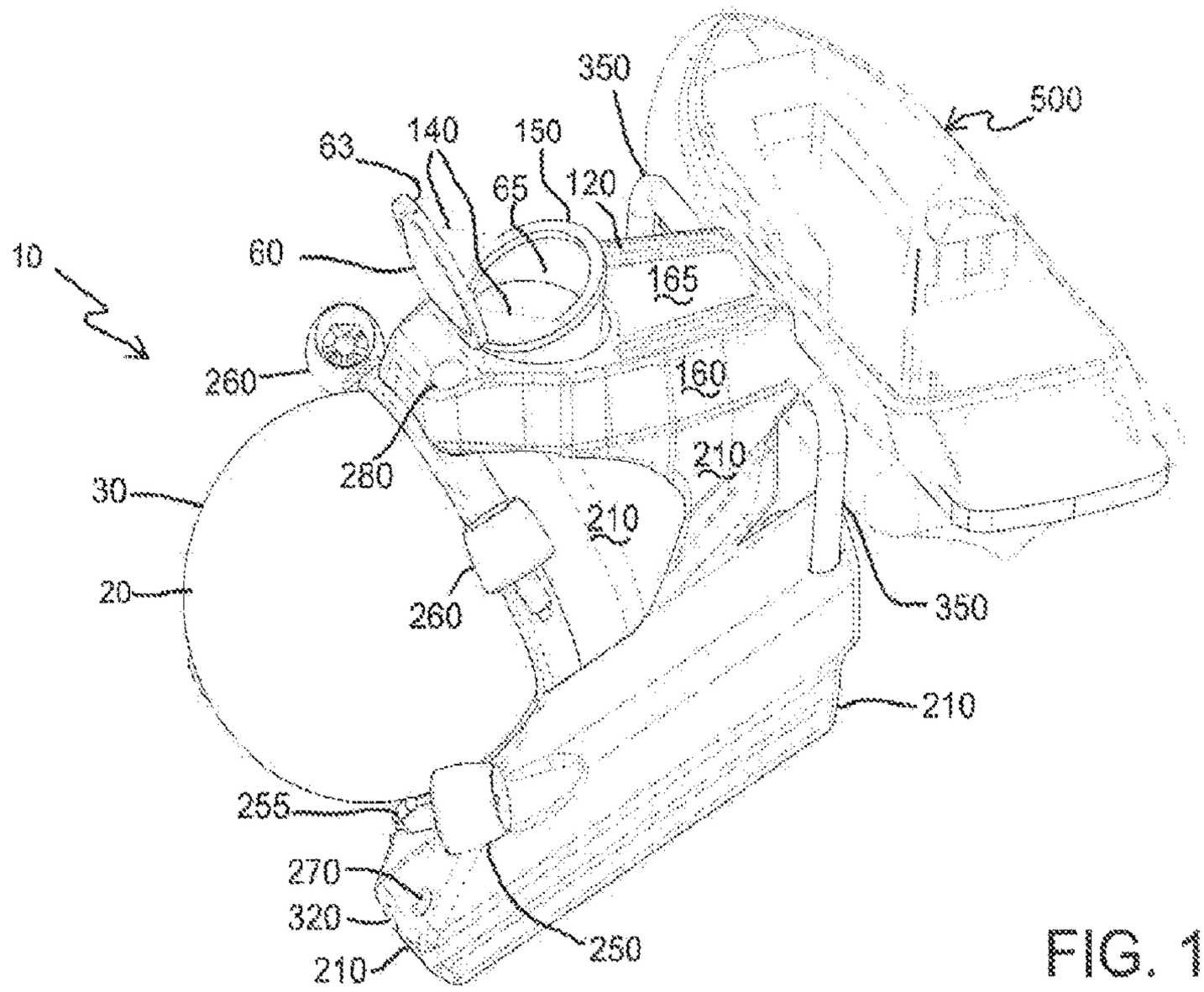
FIG. 18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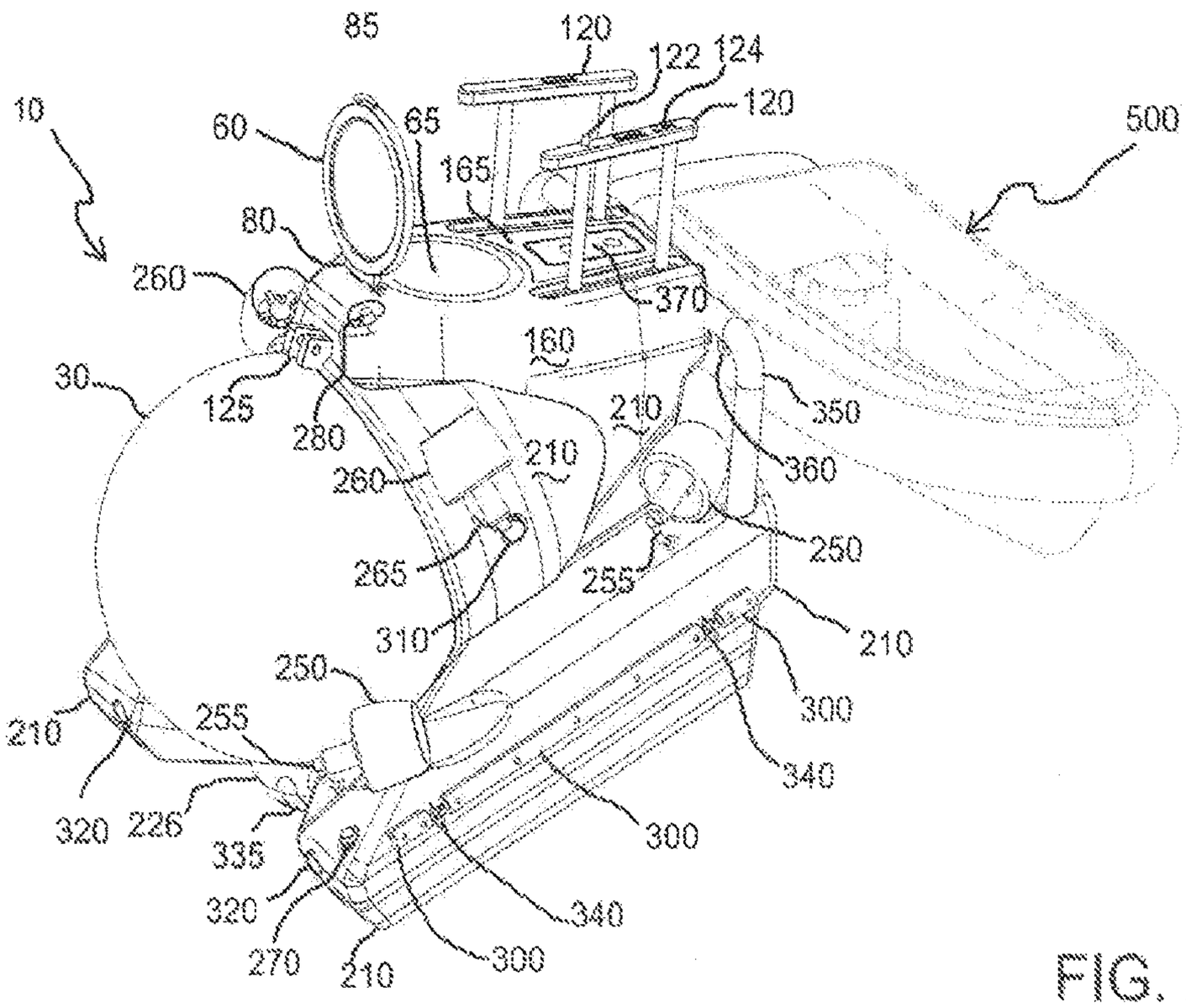
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FIG. 20

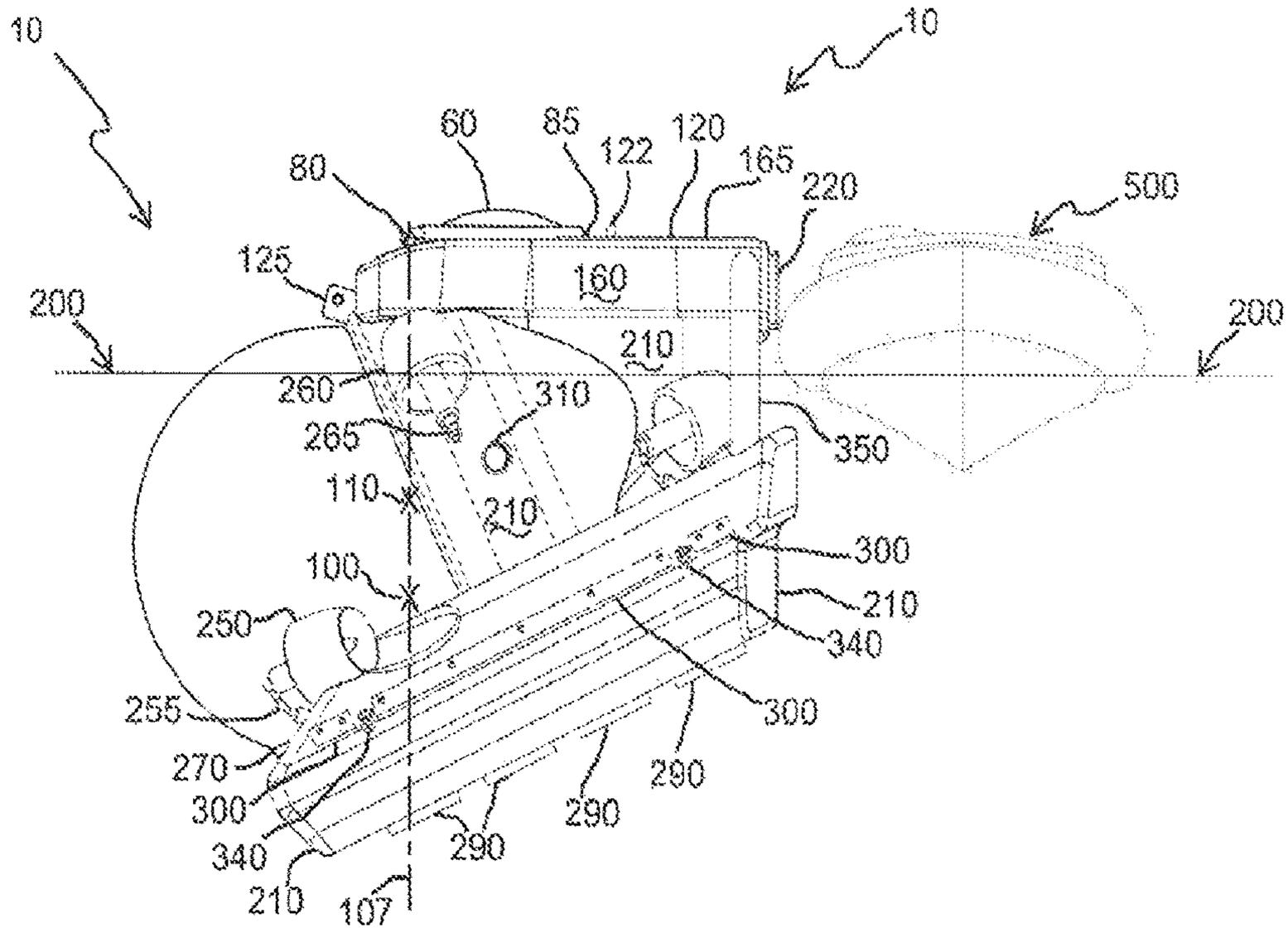
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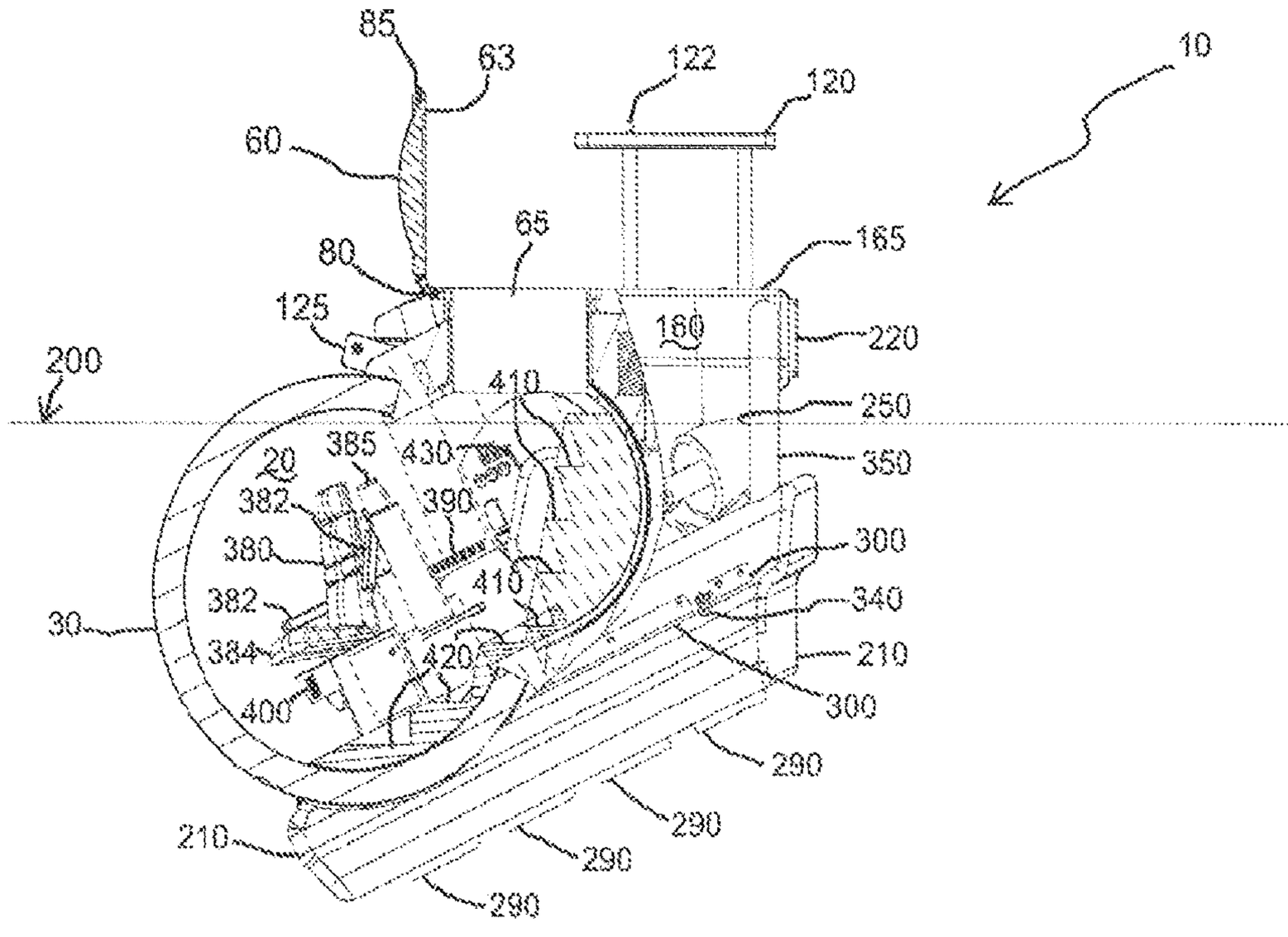
FIG. 21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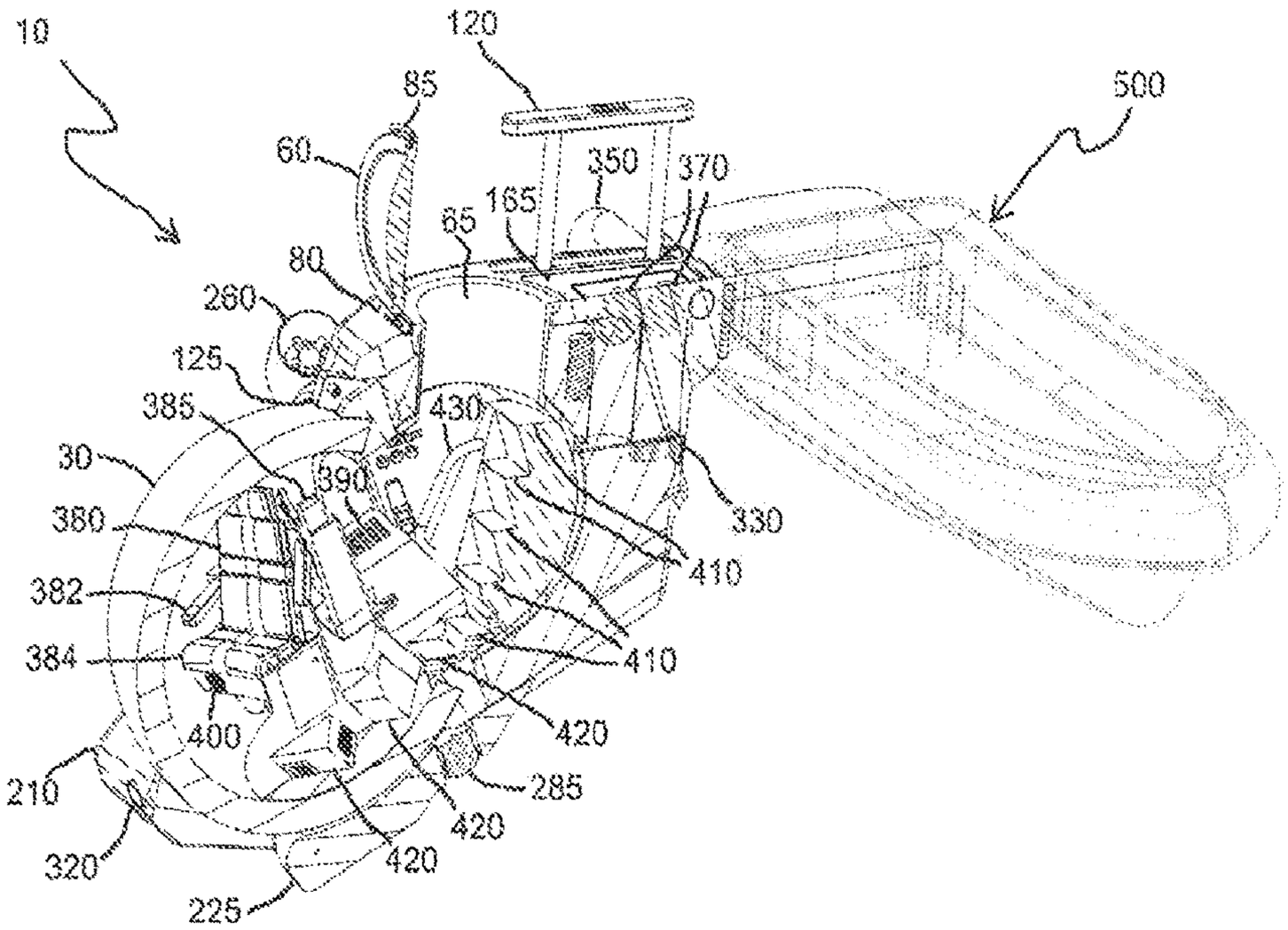
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FIG. 23

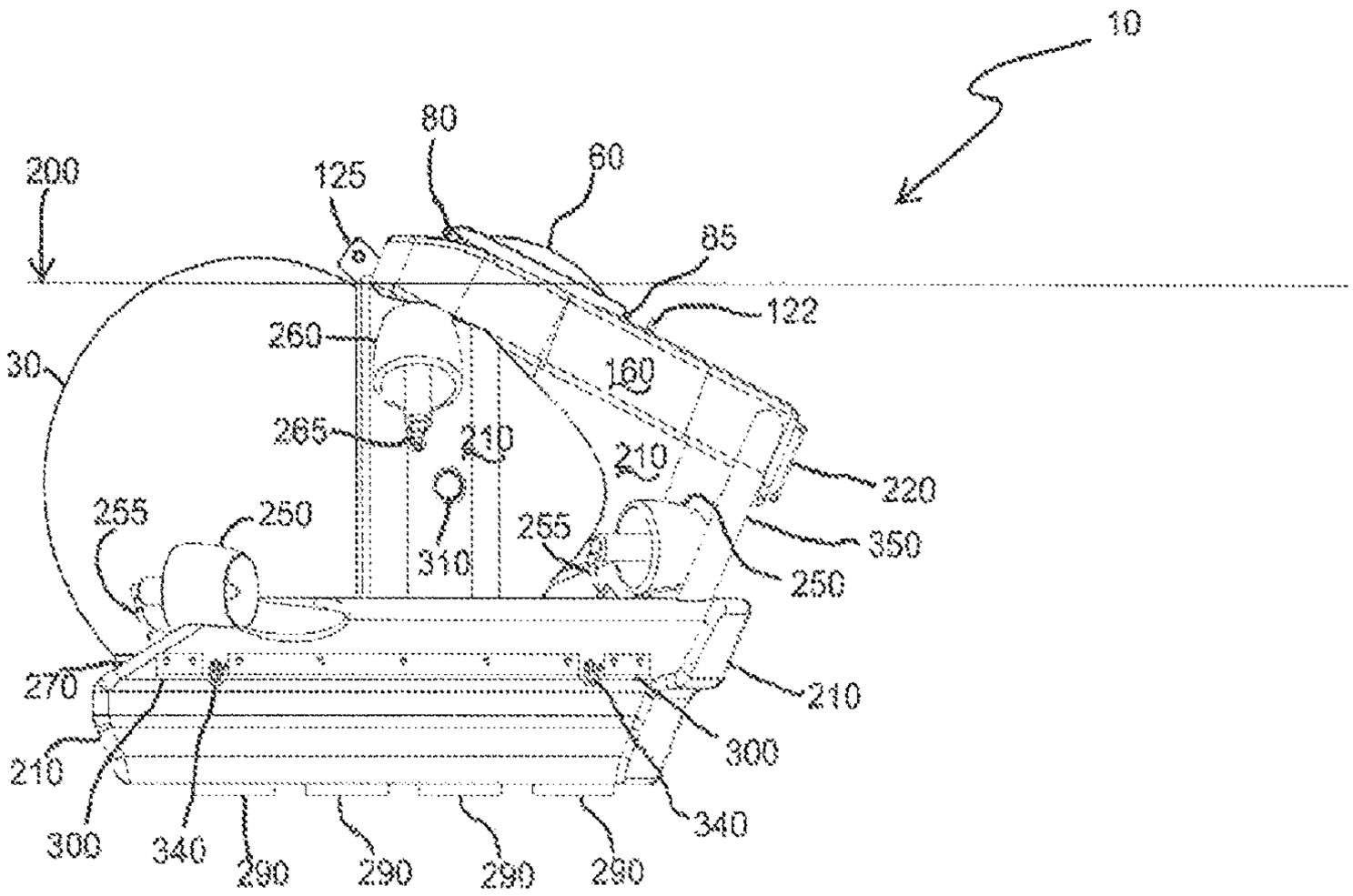
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FIG. 24

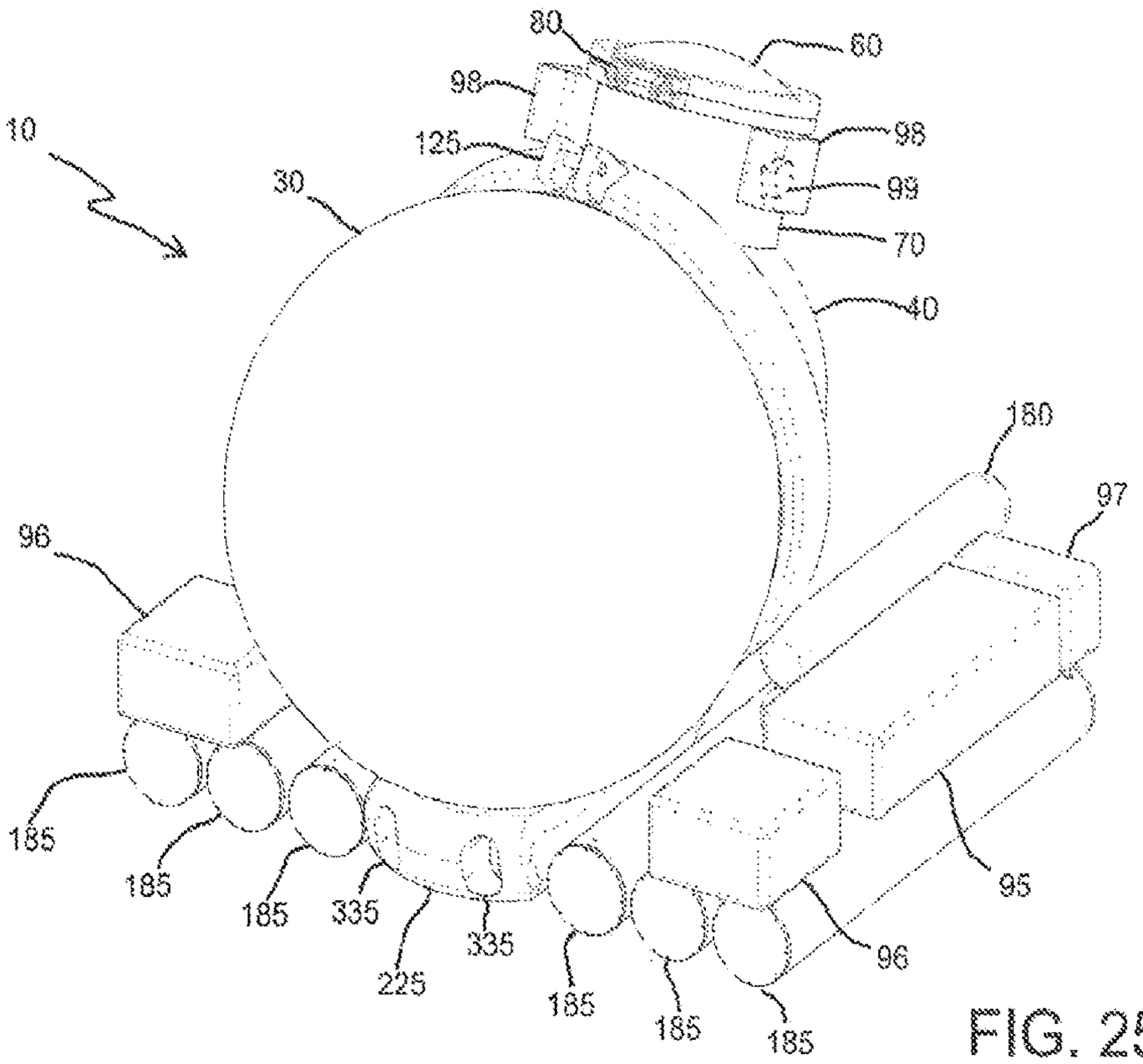
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FIG. 25

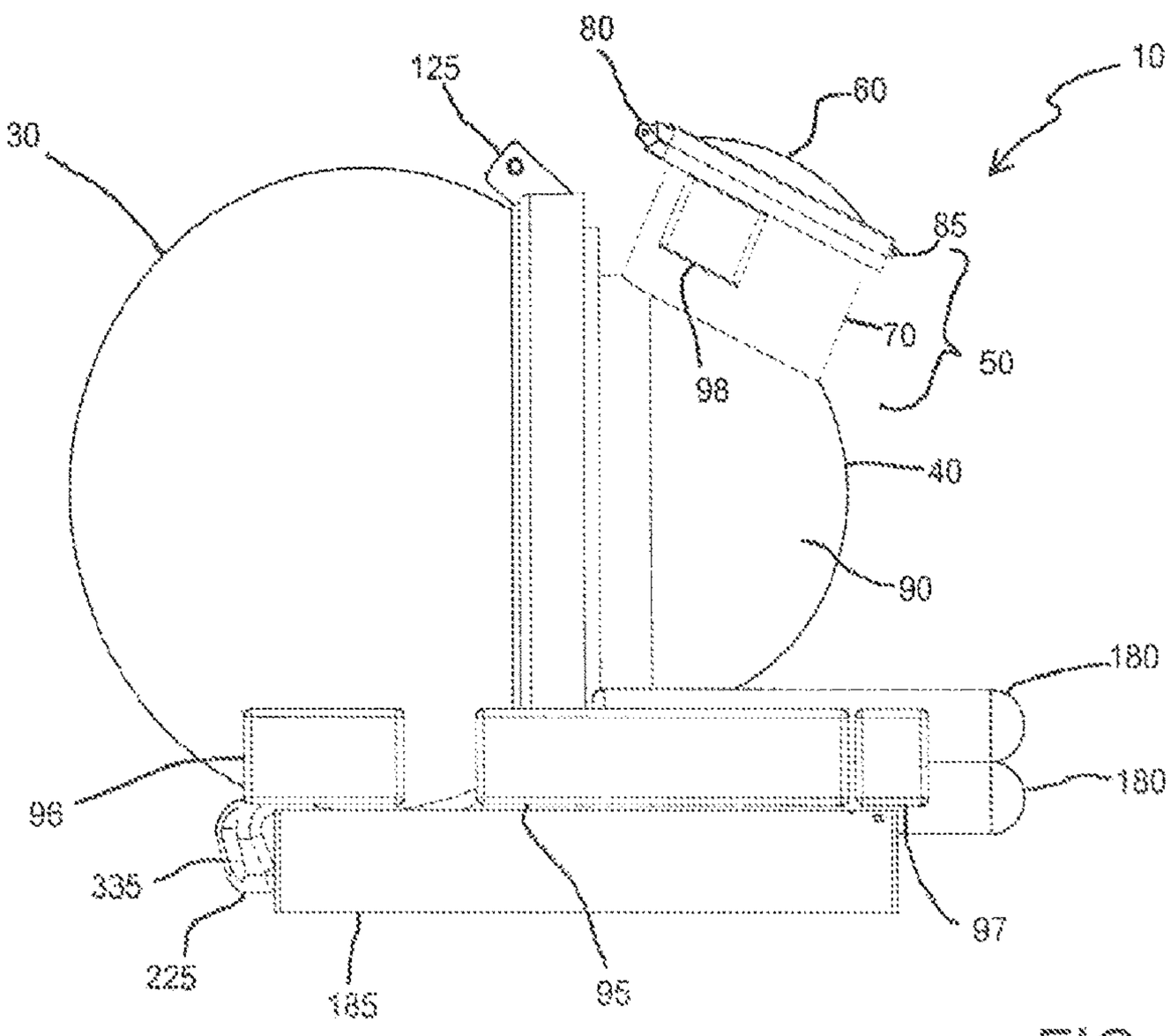
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FIG. 26

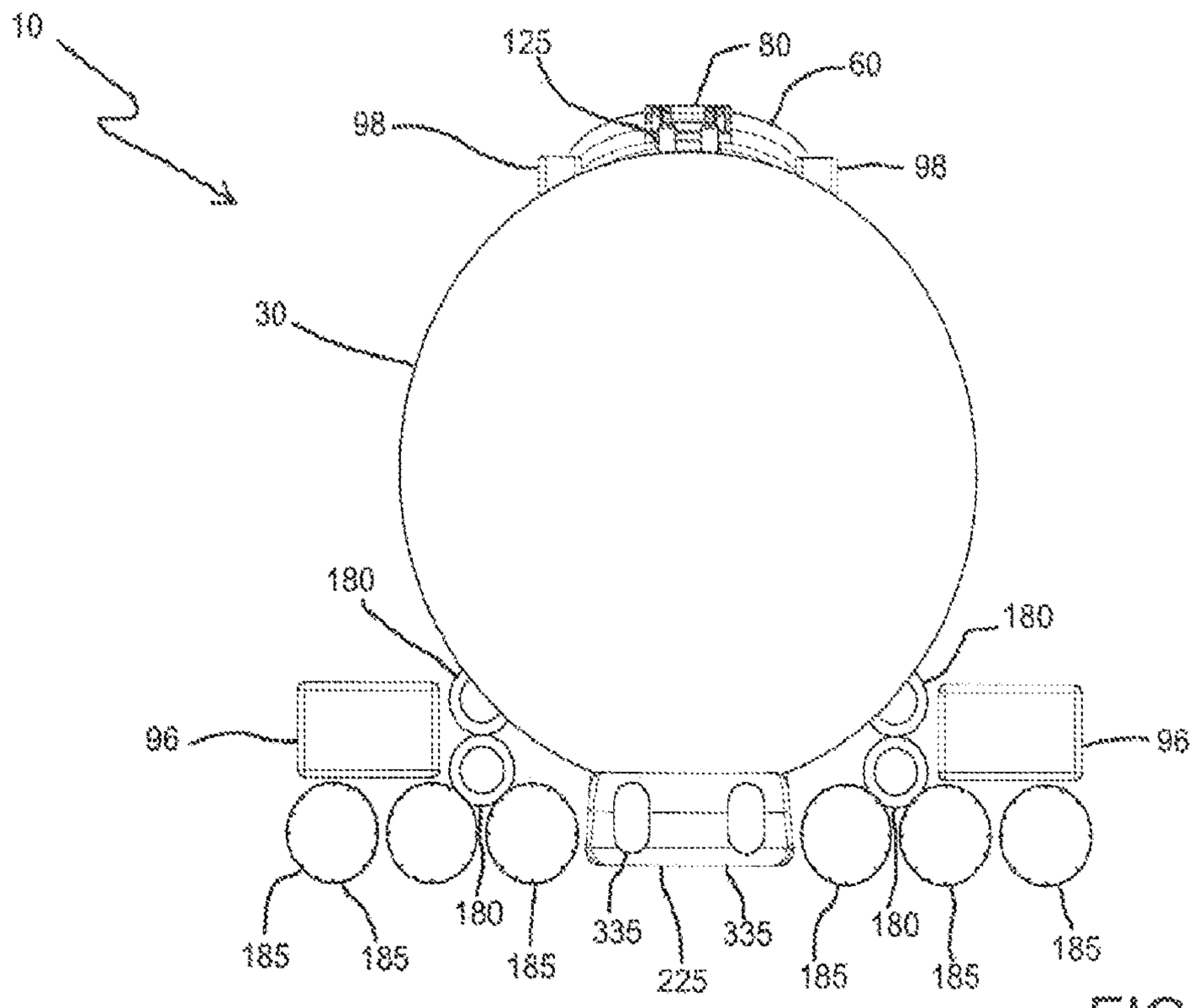
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FIG. 27

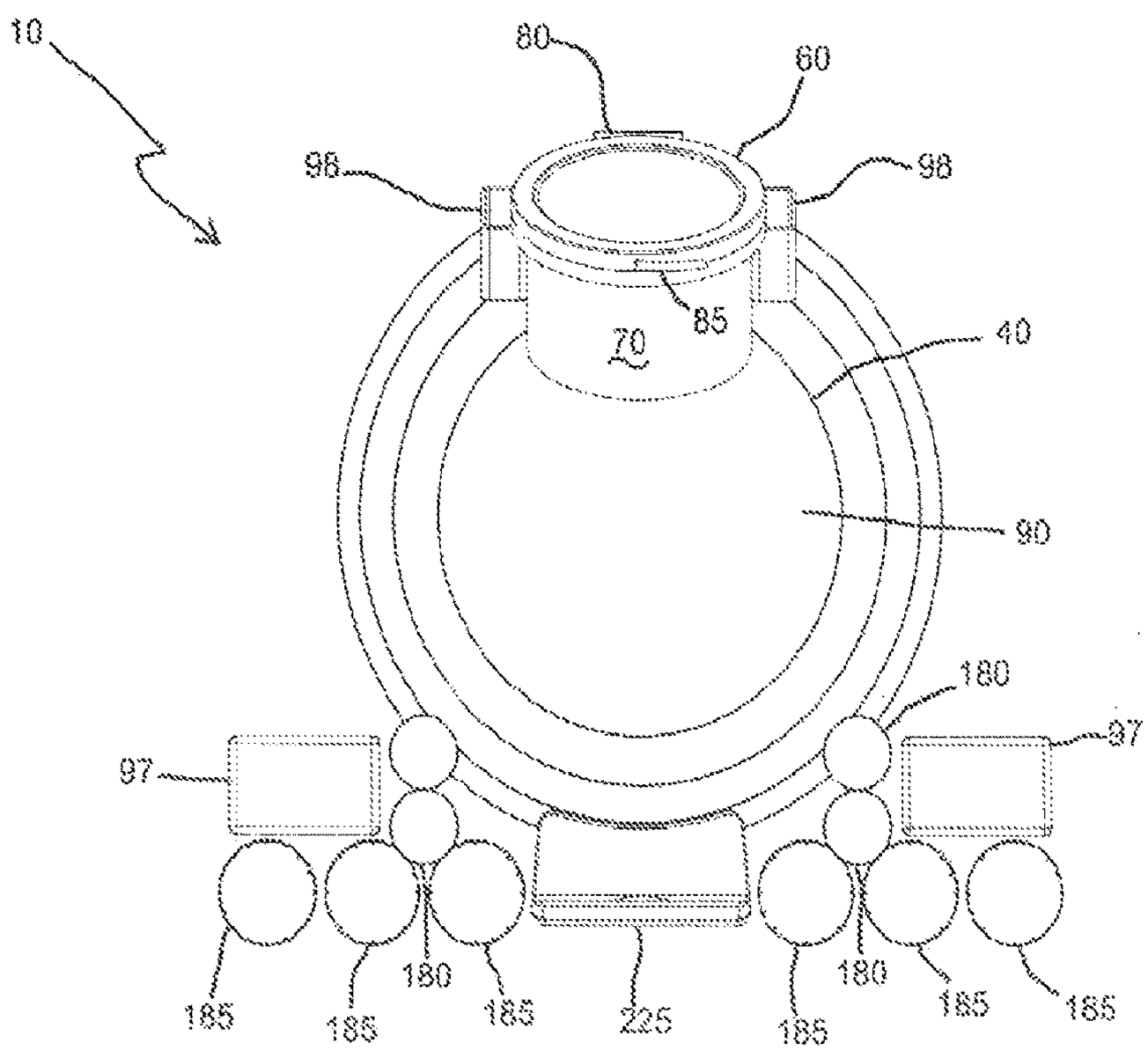
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FIG. 28

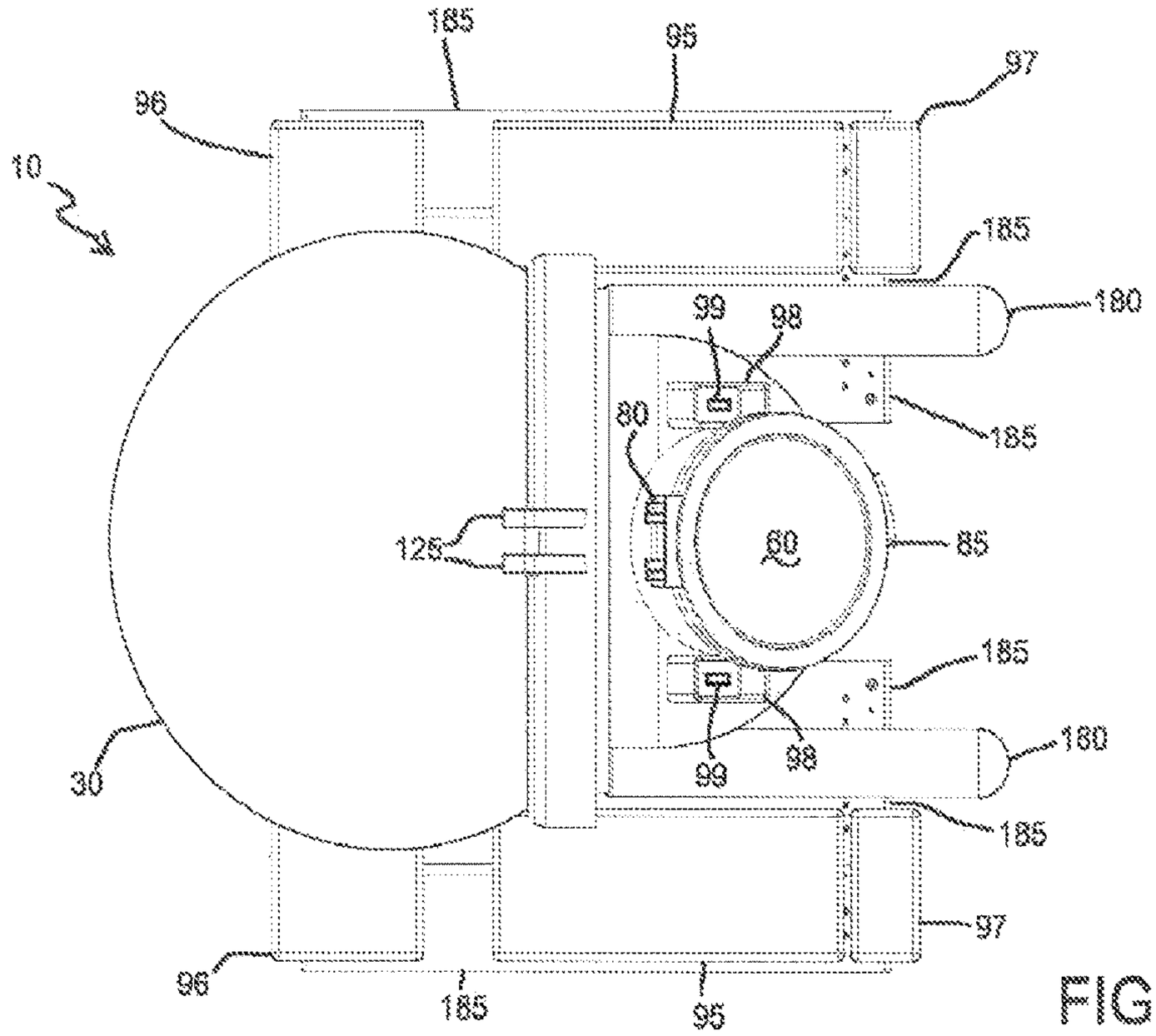
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FIG. 29

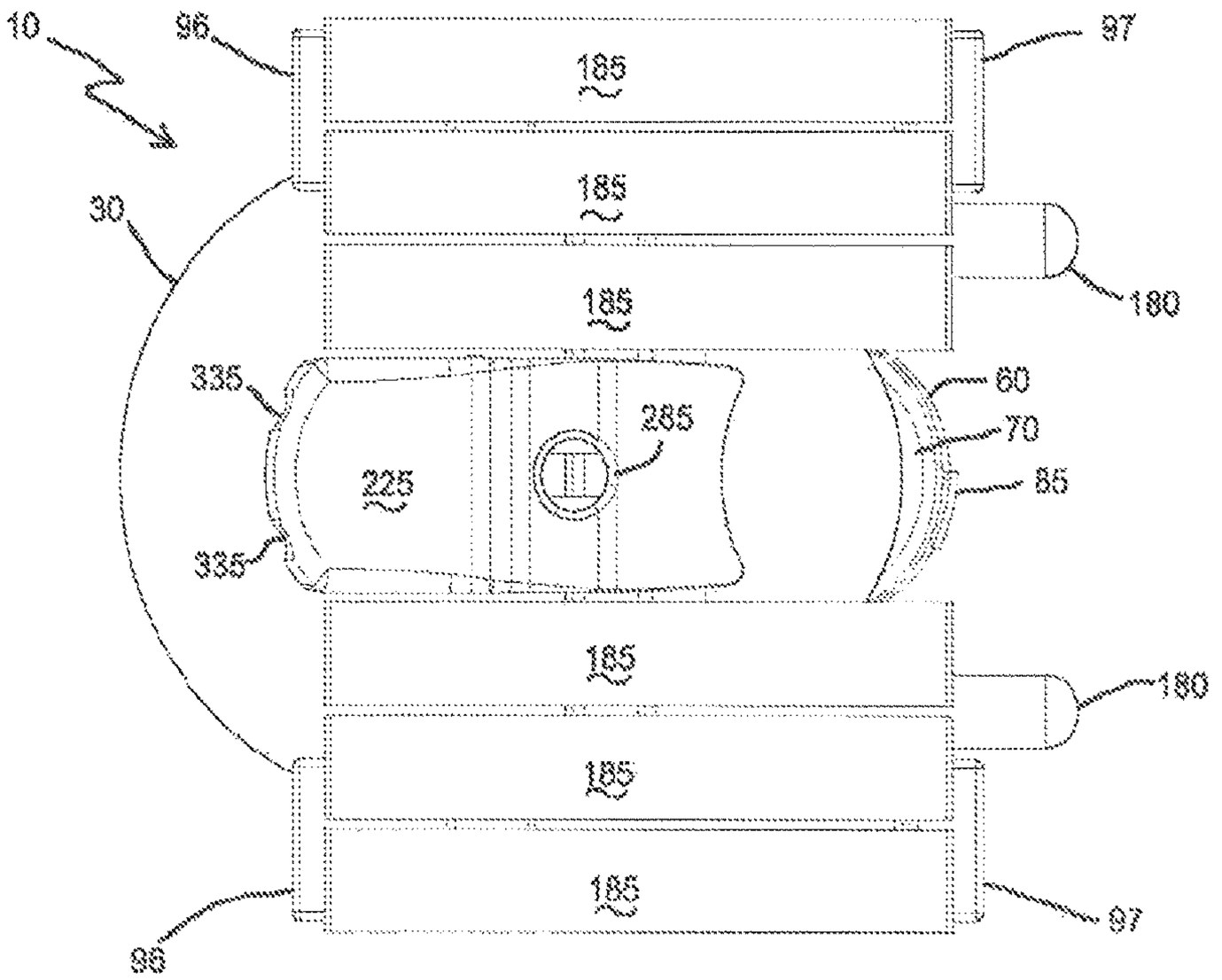
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FIG. 30

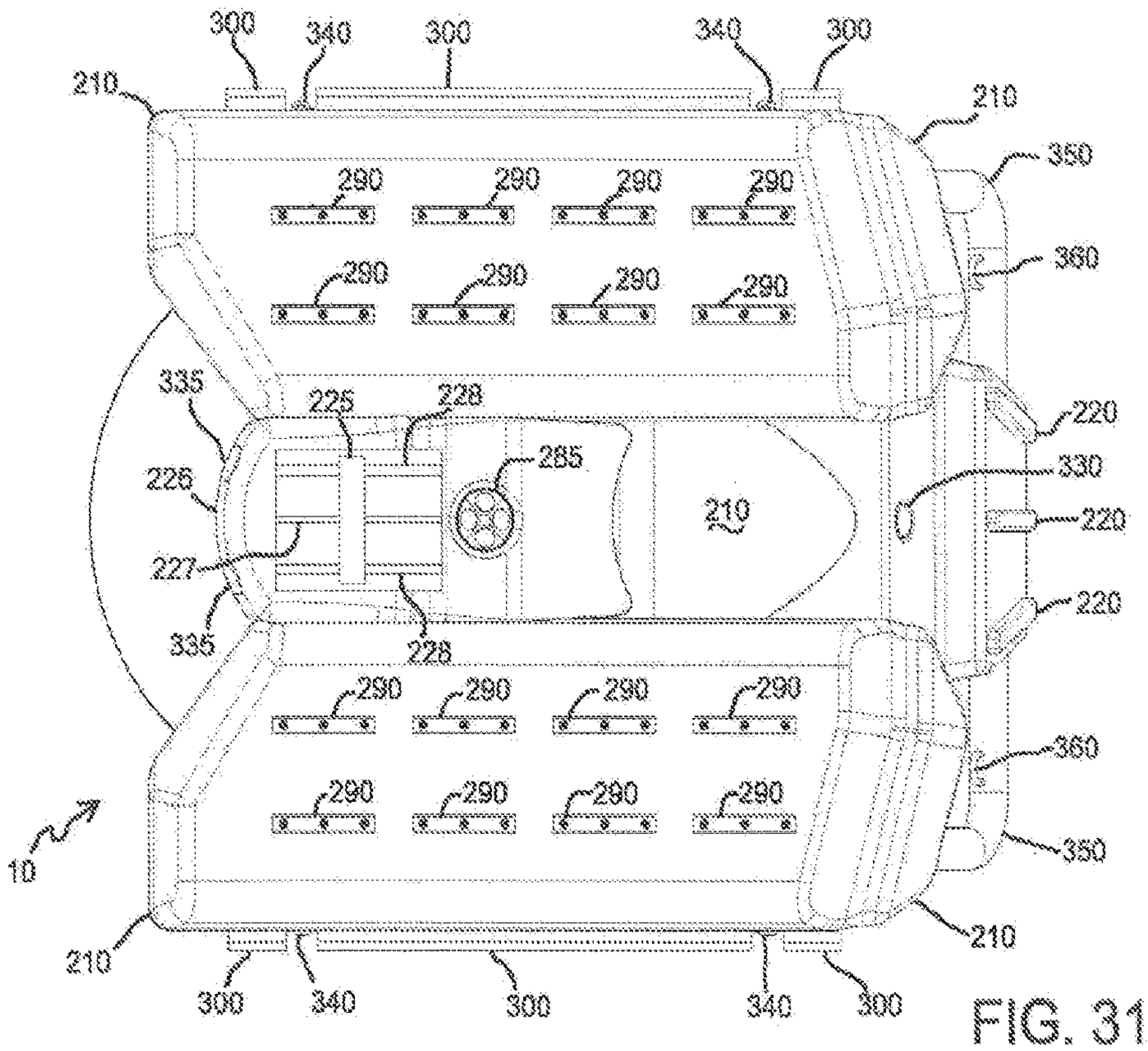
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FIG. 31

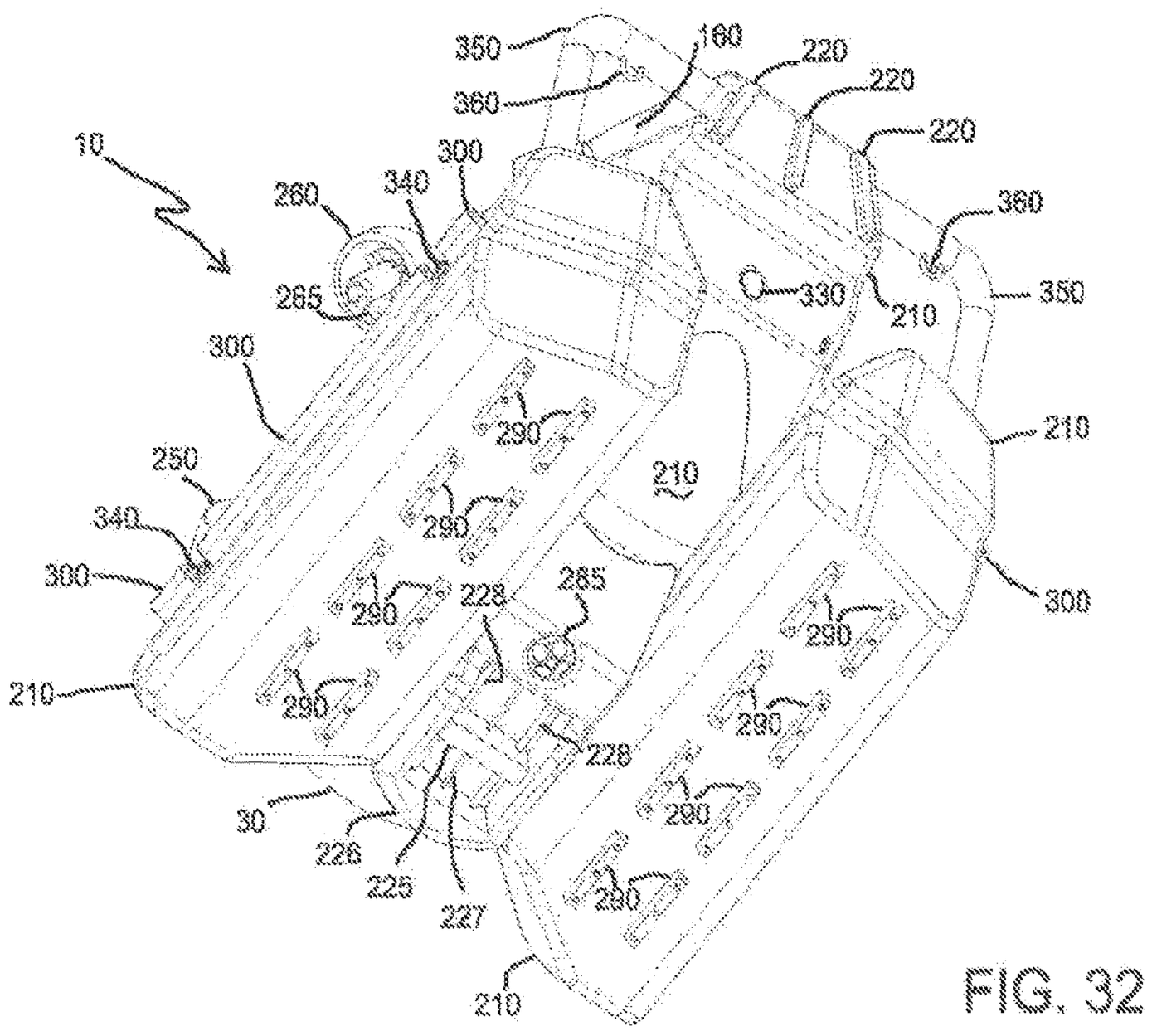
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FIG. 32

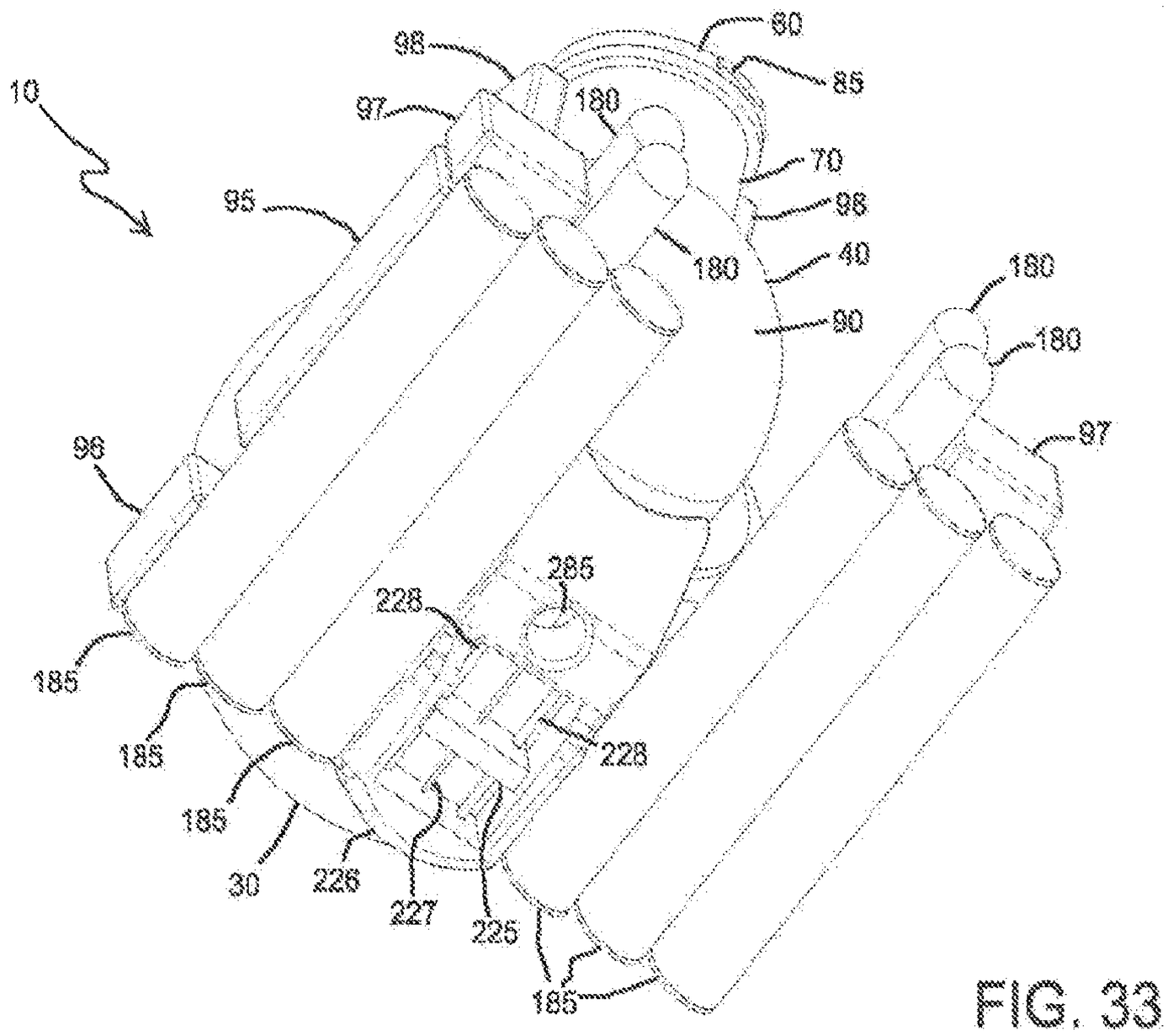
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FIG. 33

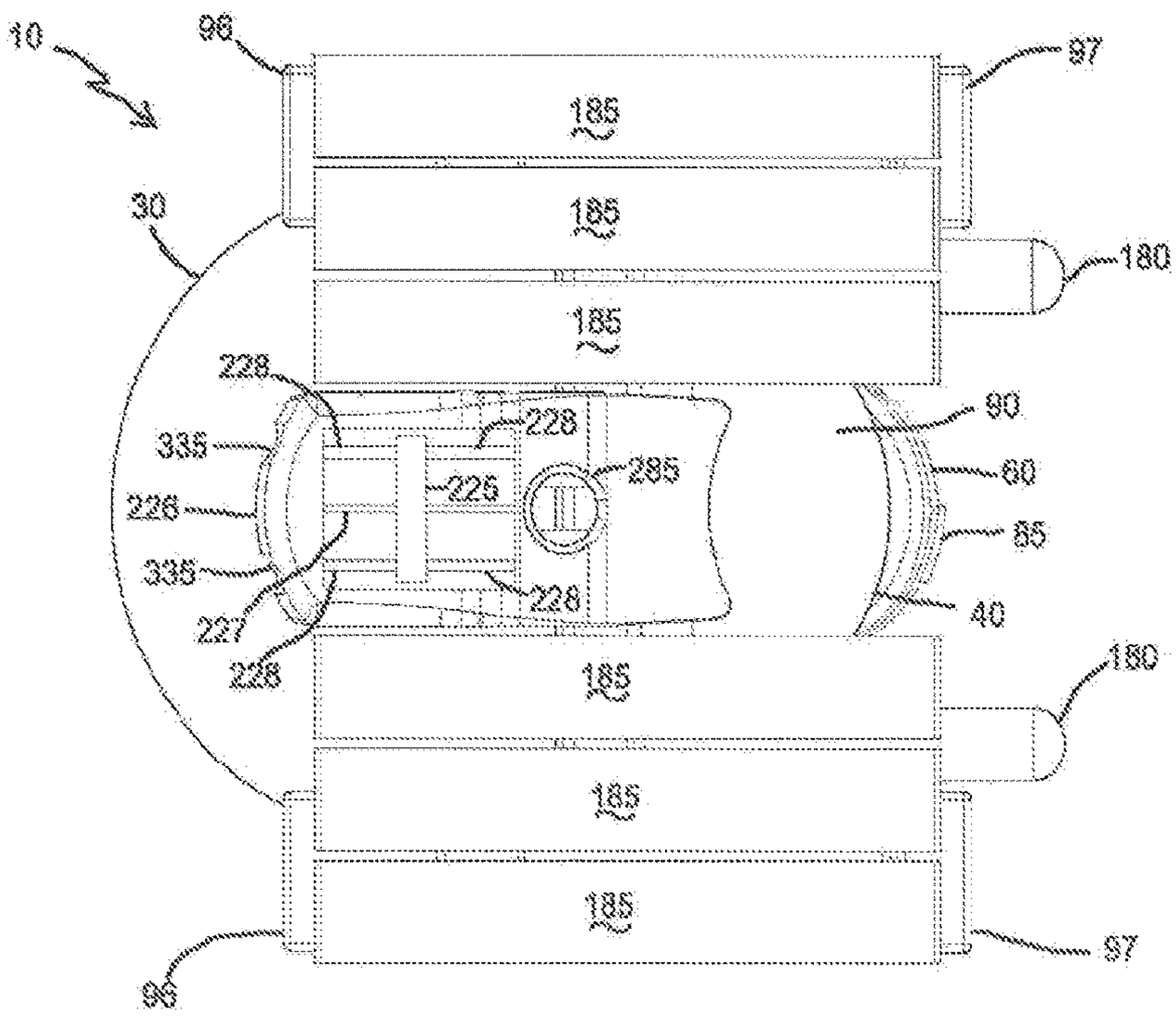
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FIG. 34

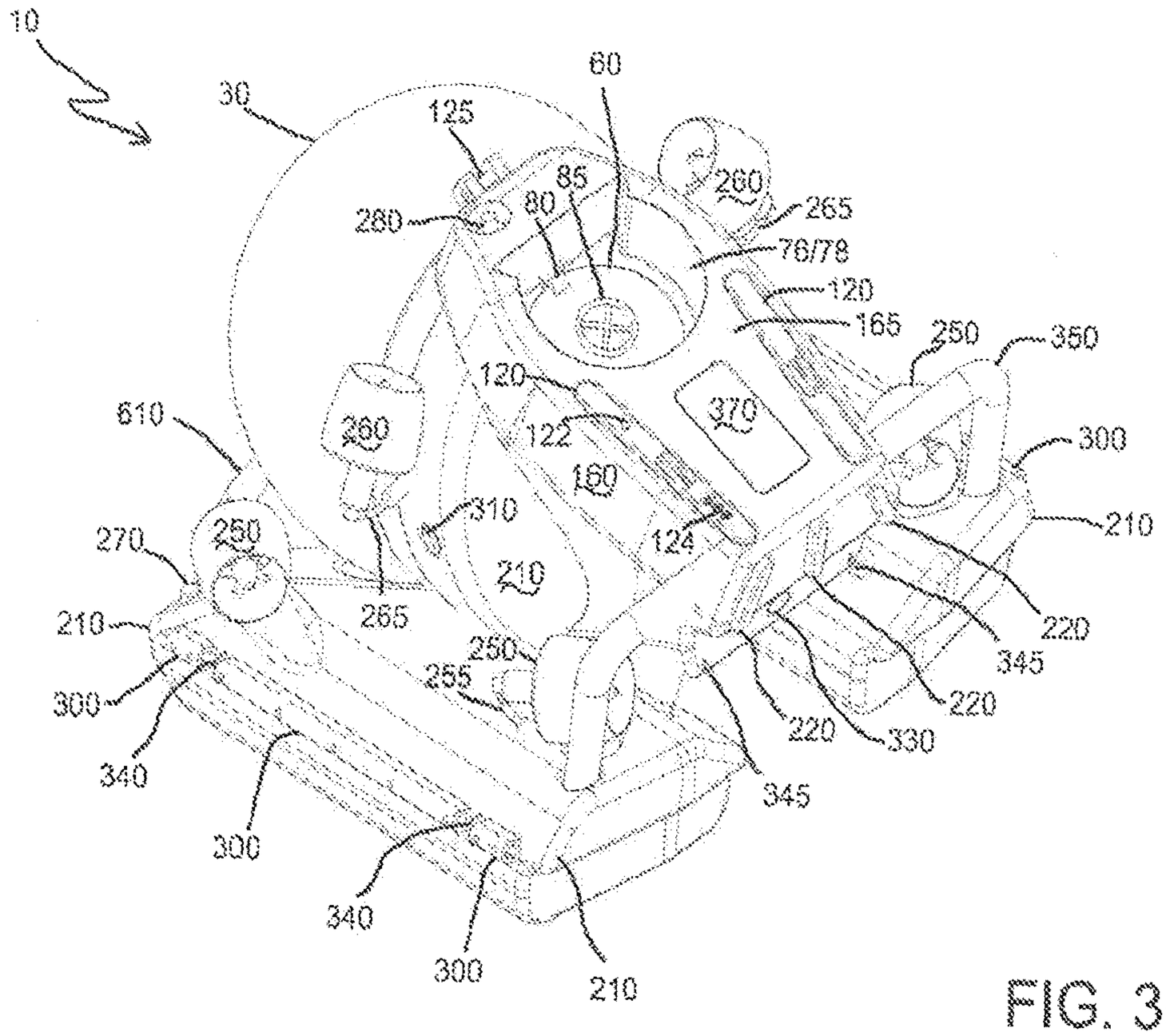
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FIG. 35

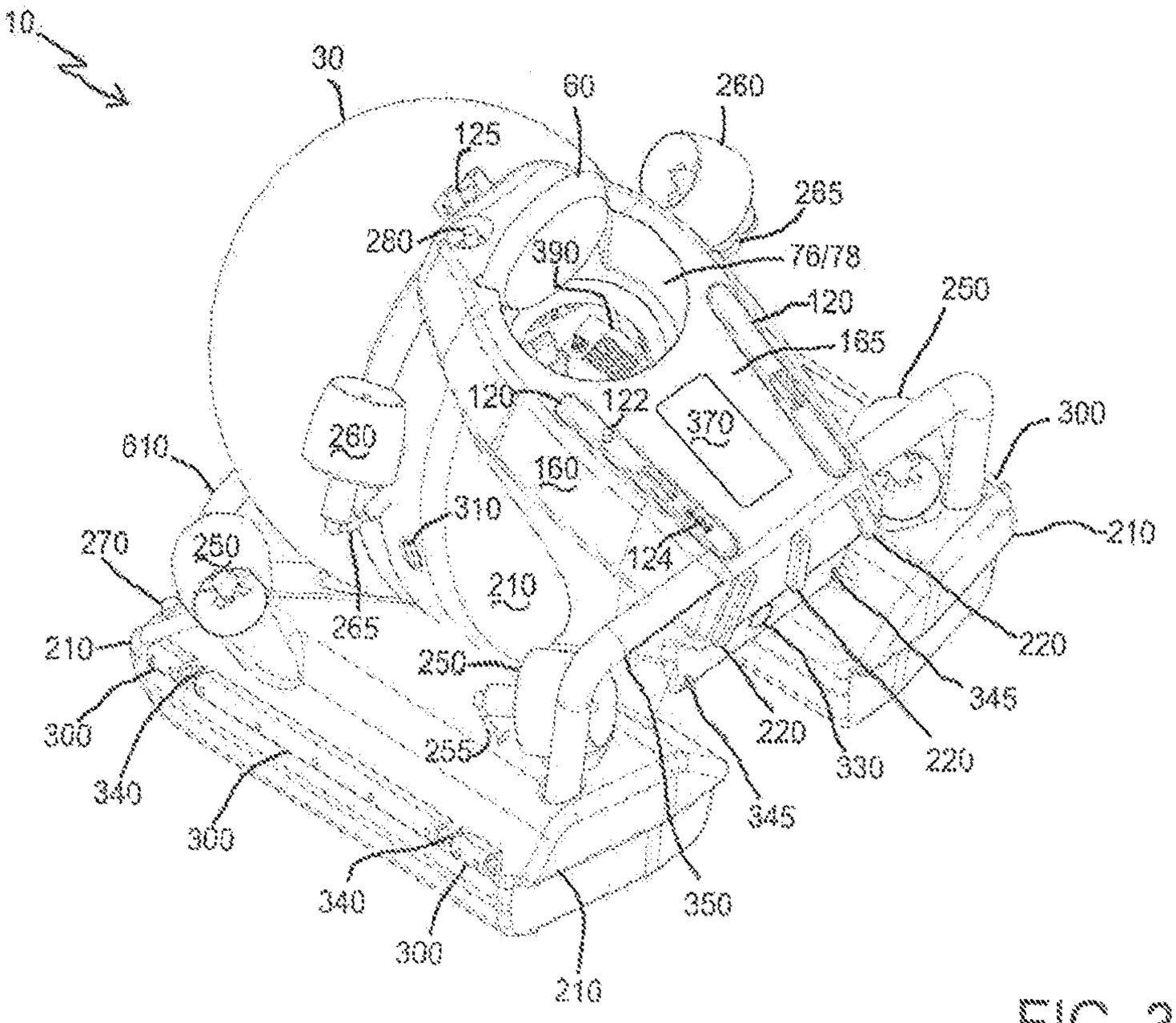
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FIG. 36

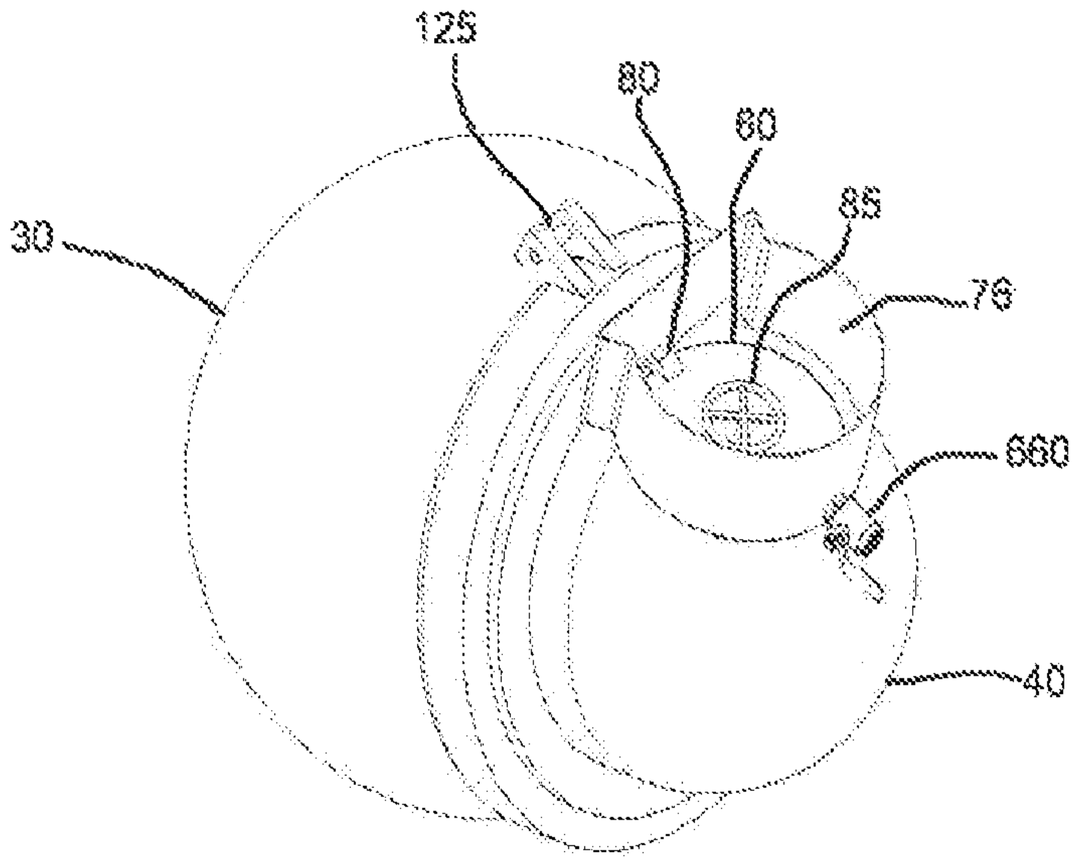

FIG. 37

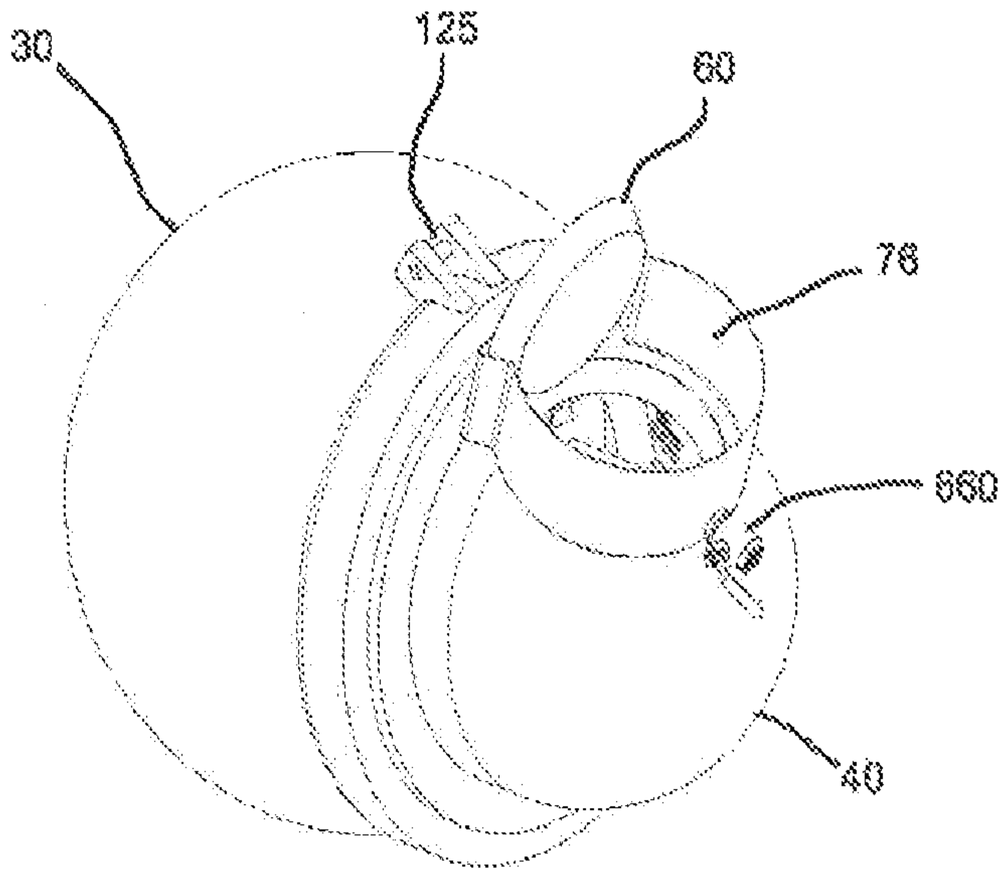

FIG. 38

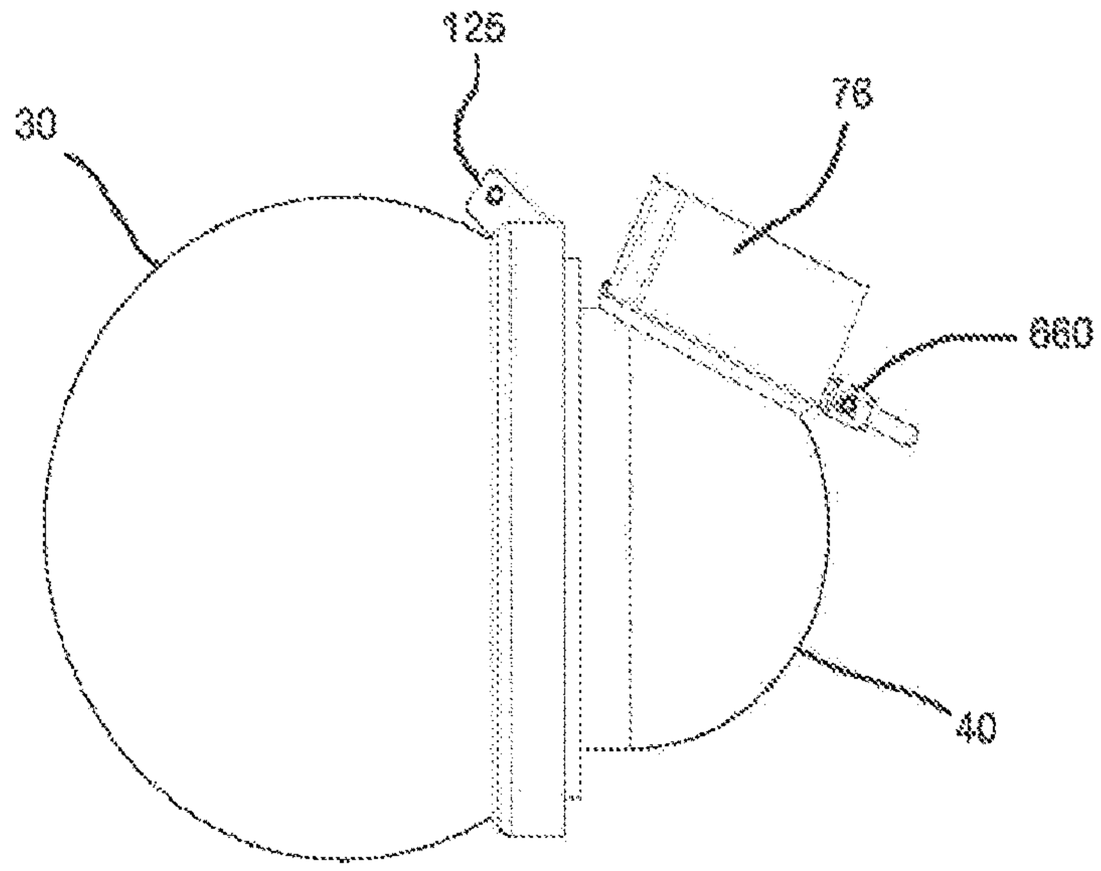
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FIG. 39

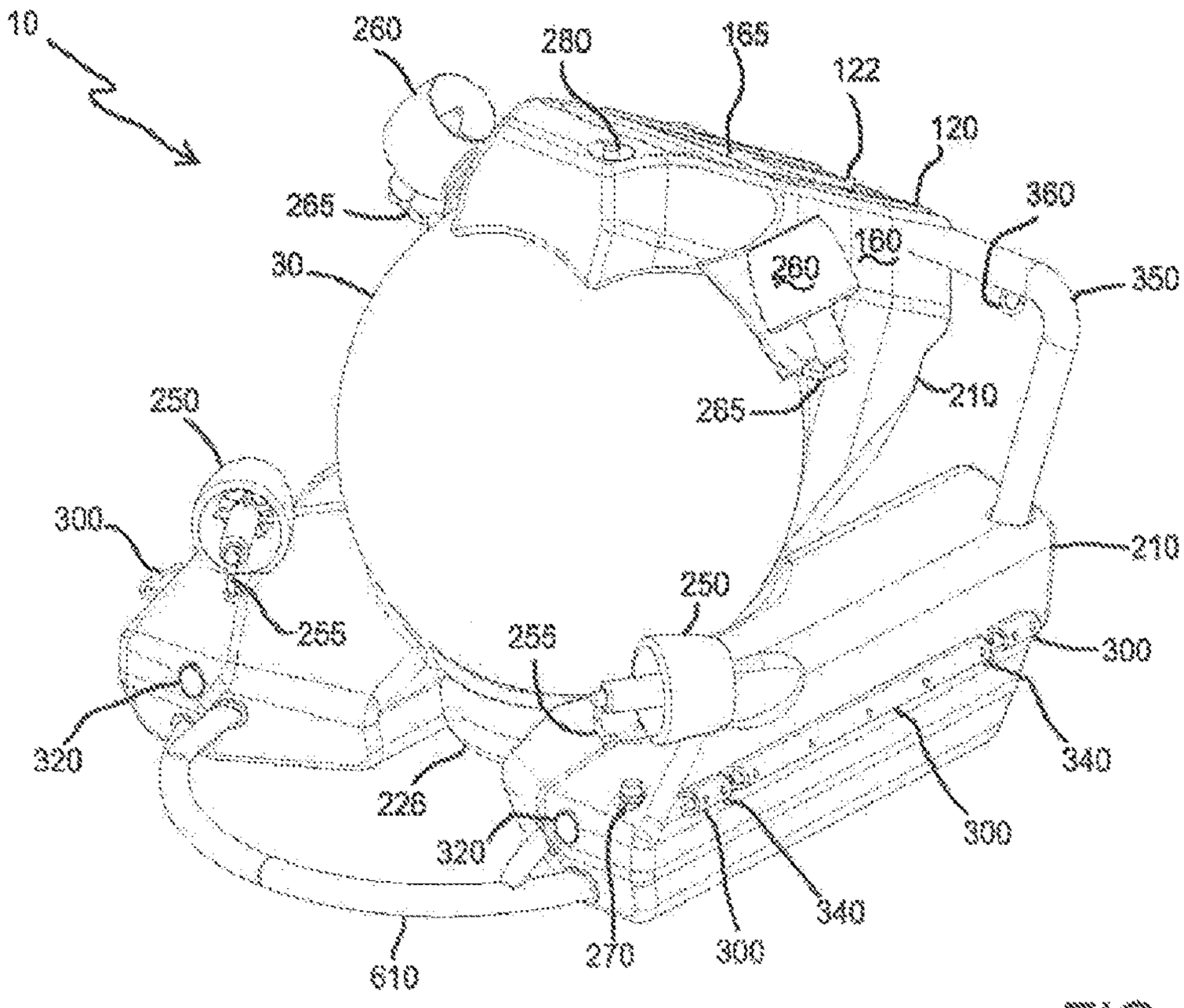
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FIG. 40

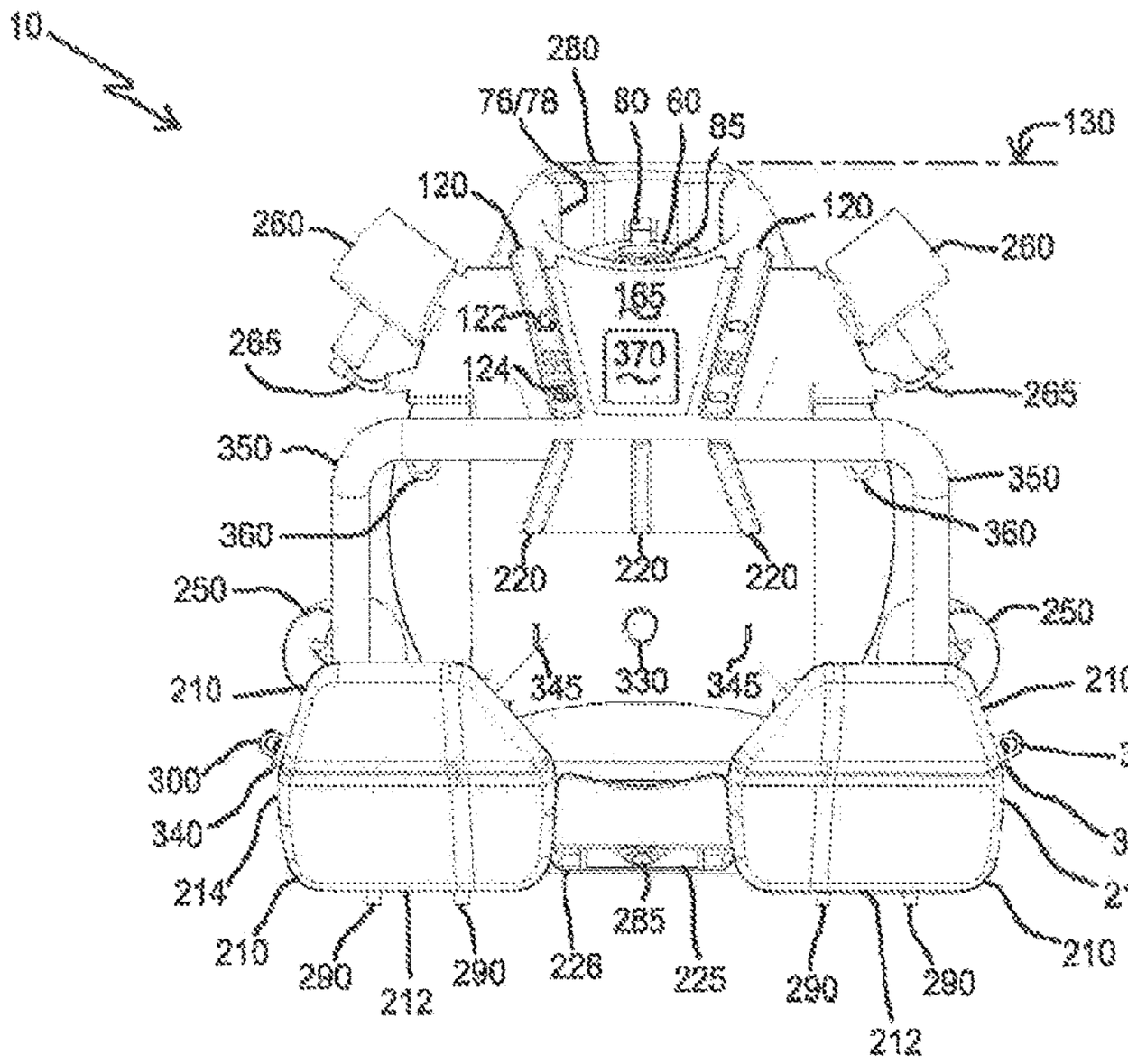
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FIG. 41

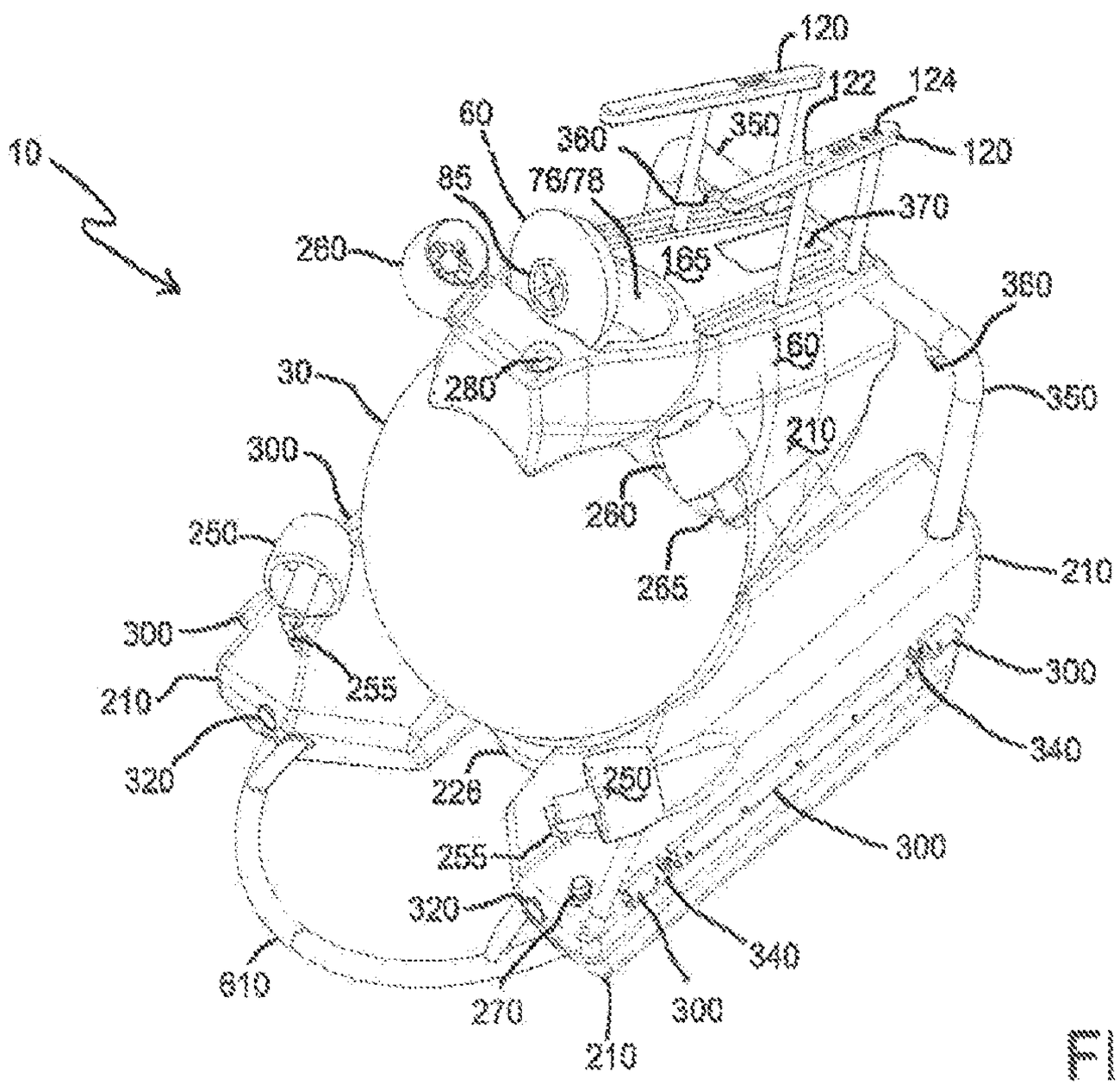
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FIG. 42

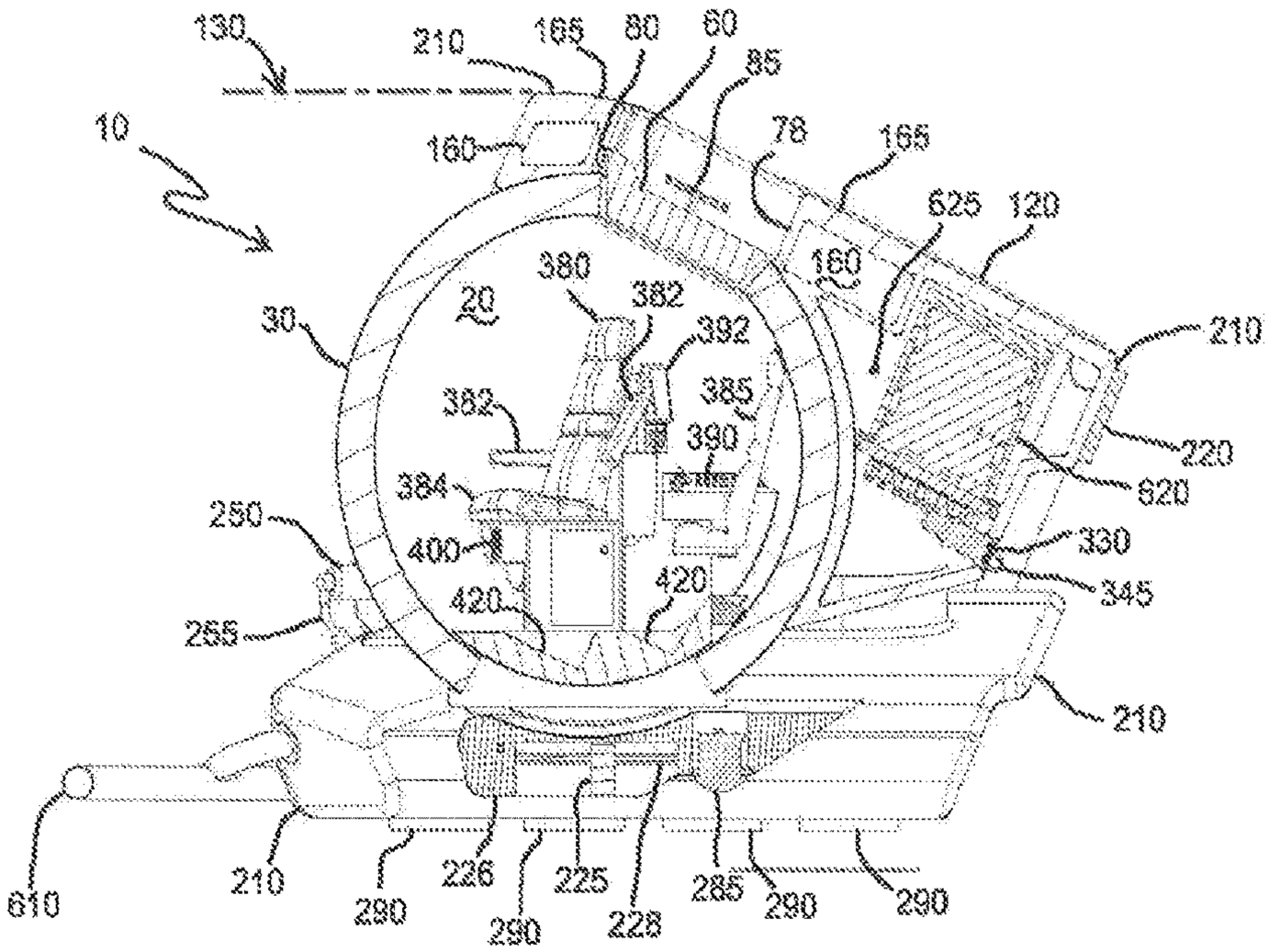
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FIG. 43

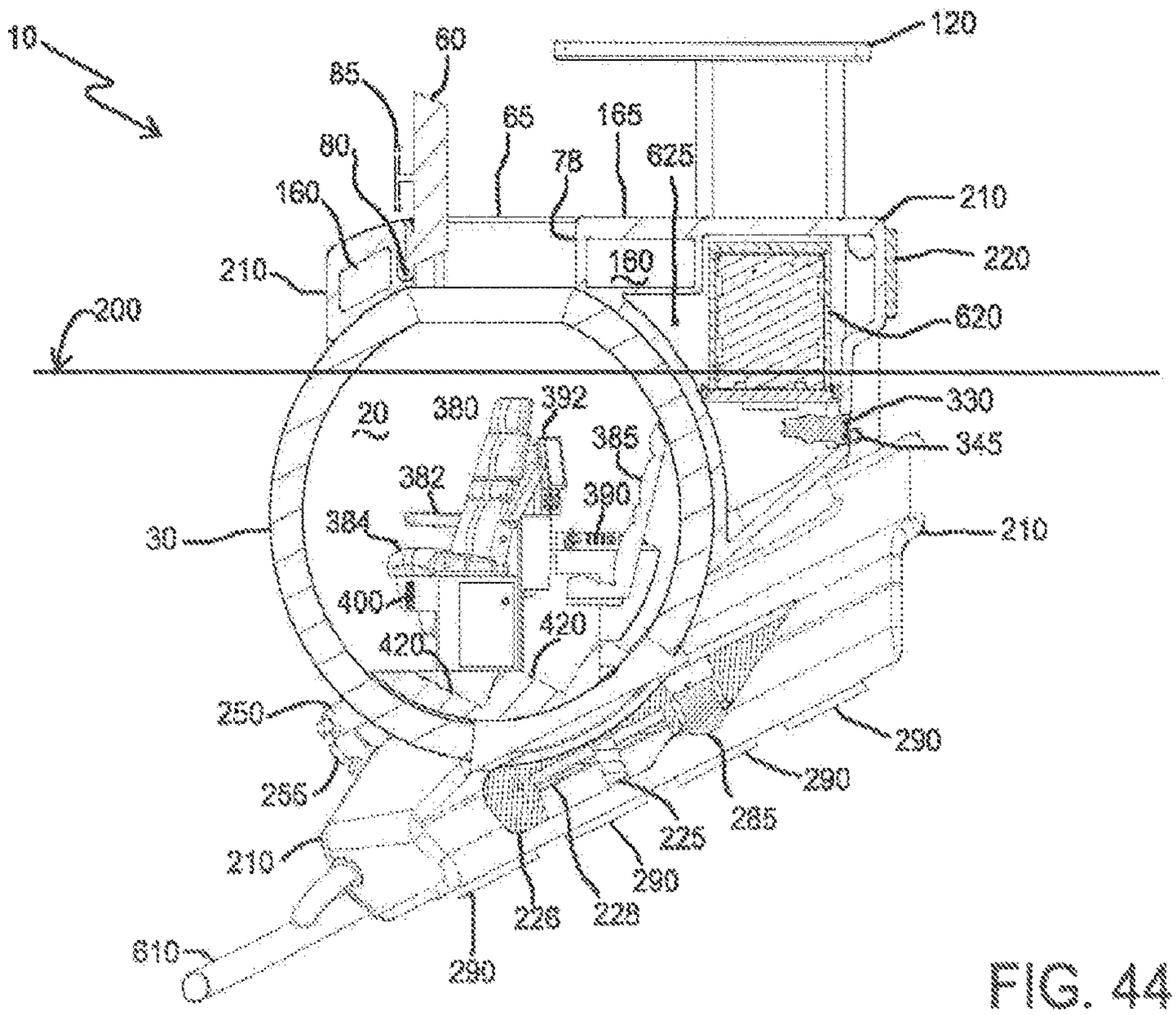
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FIG. 44

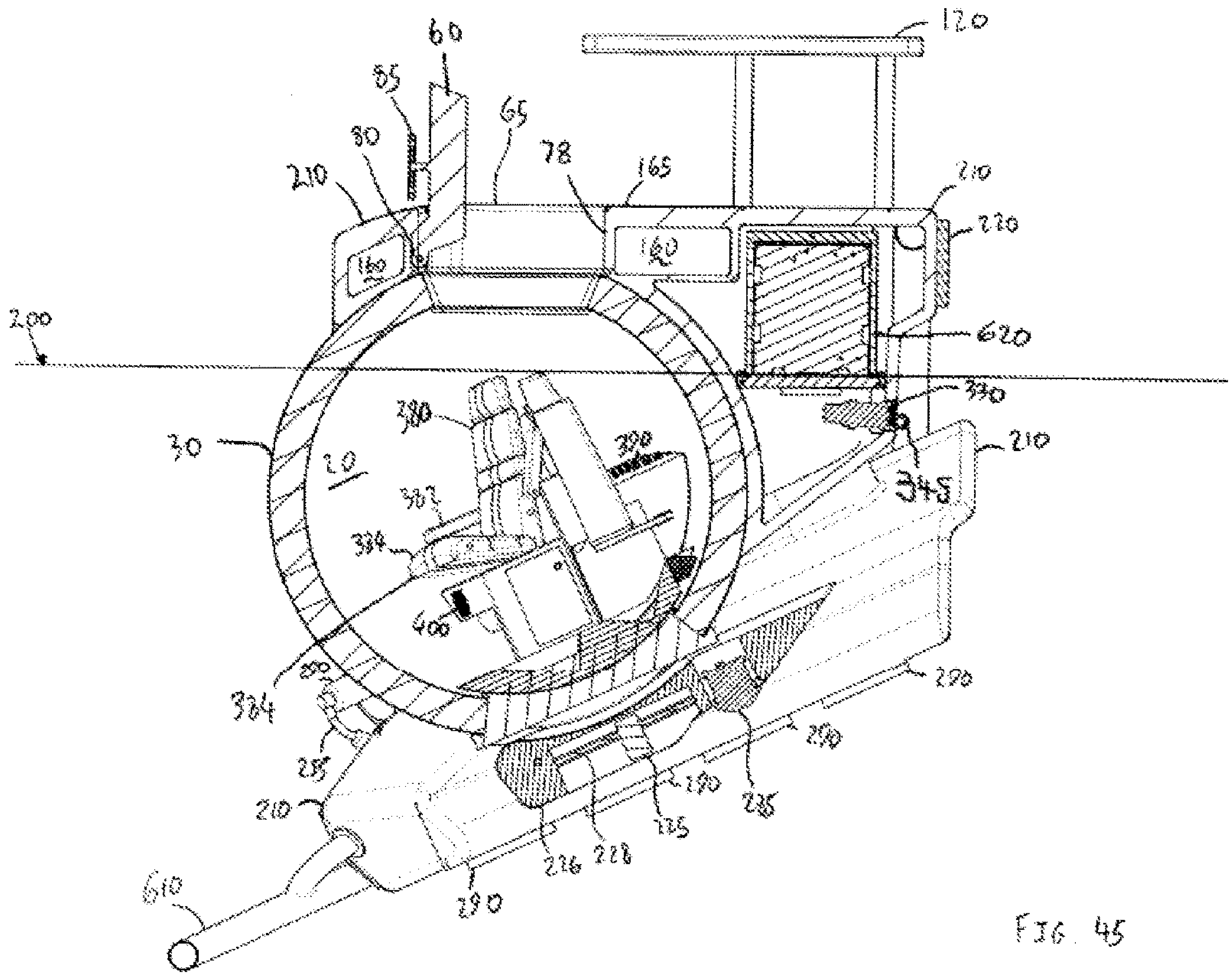
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FIG. 45

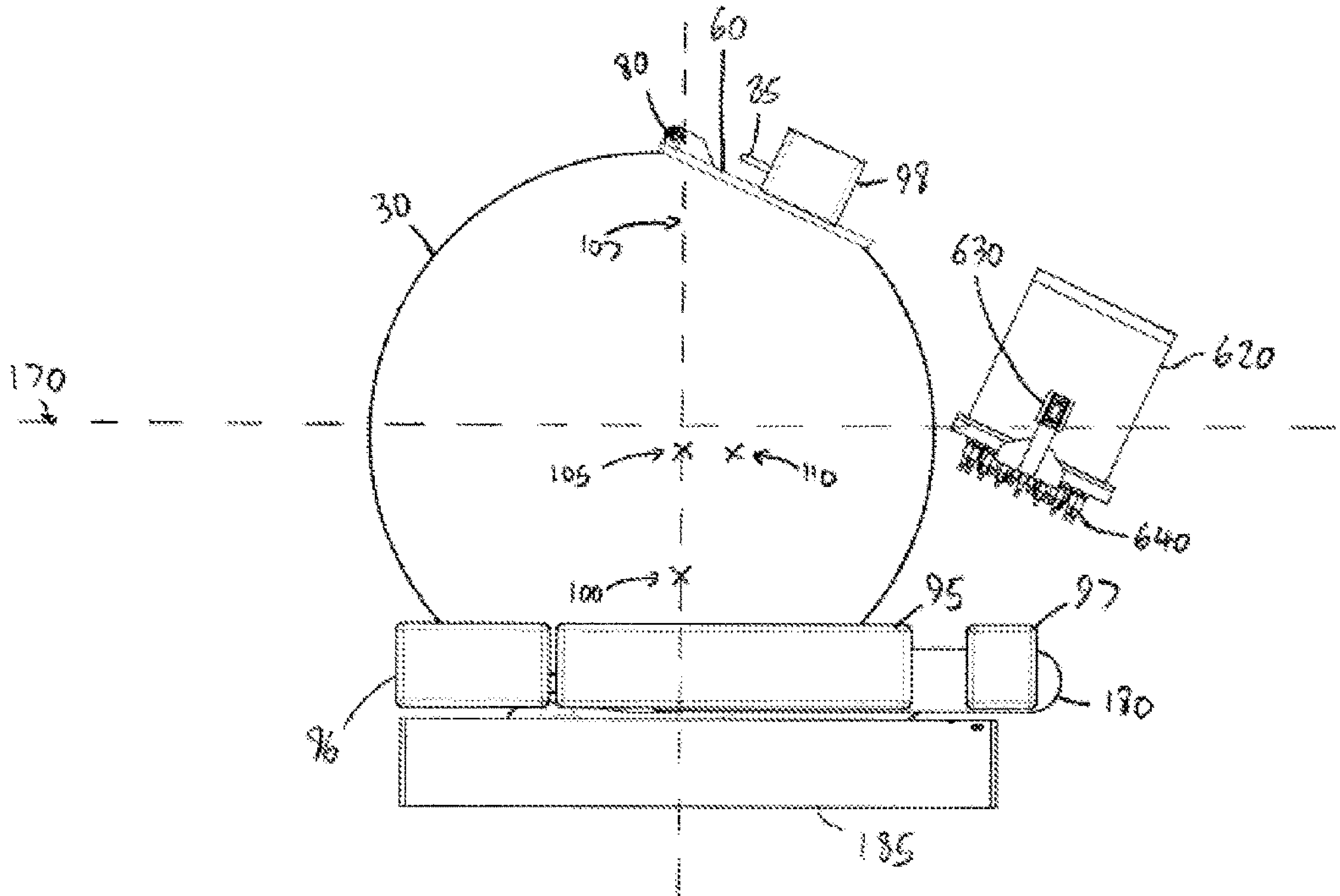
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FIG. 46

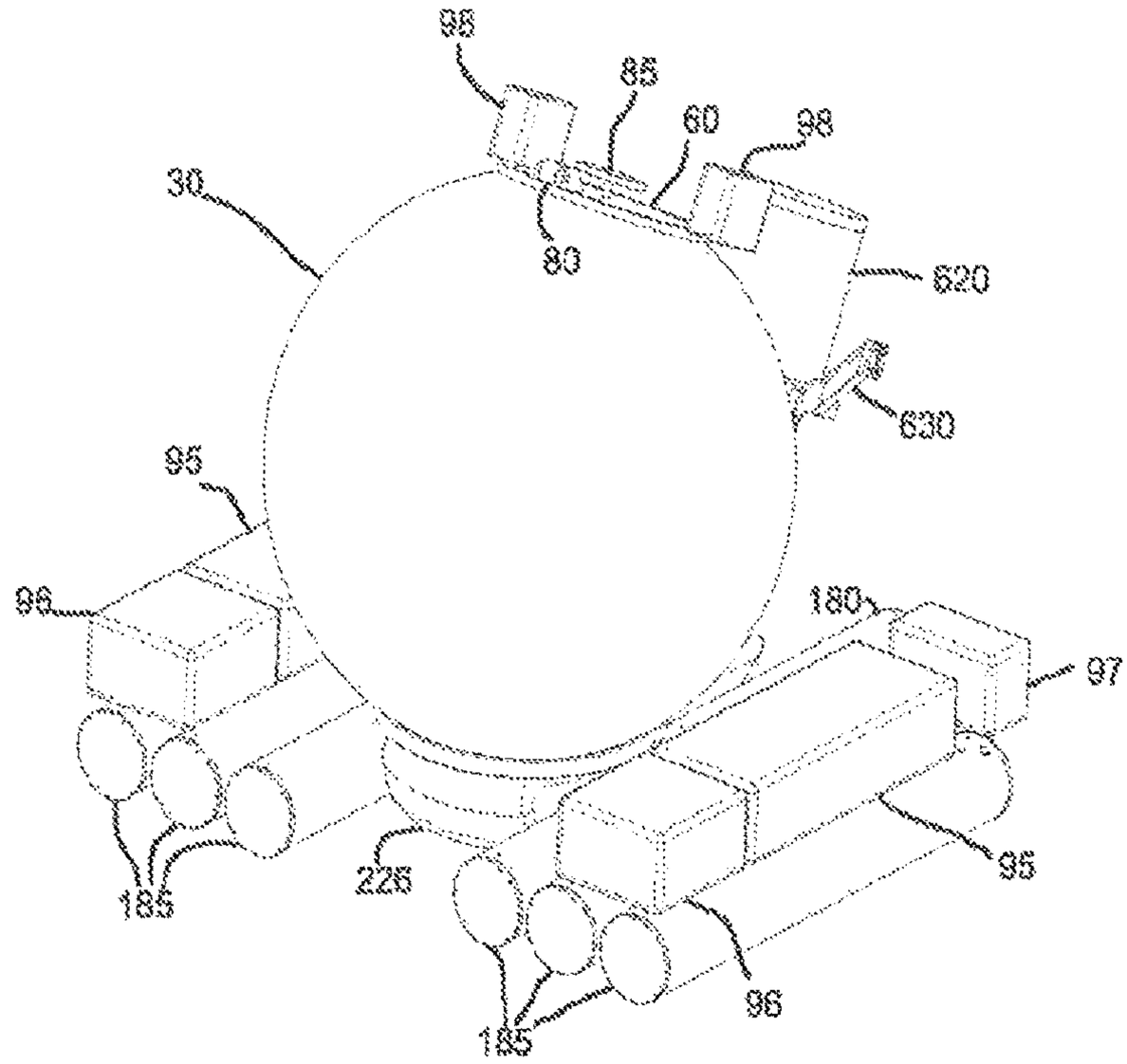
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FIG. 47

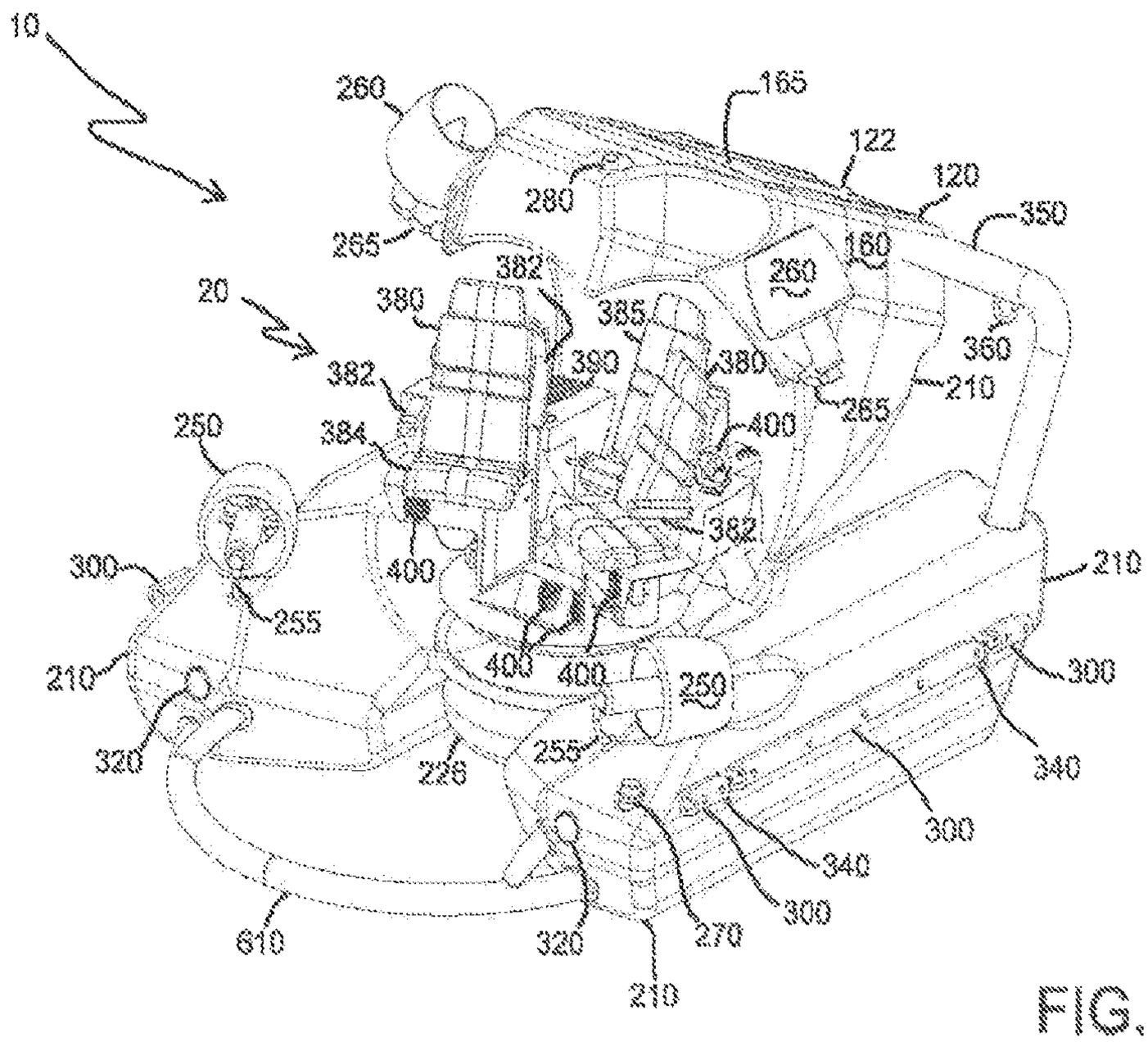
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FIG. 48

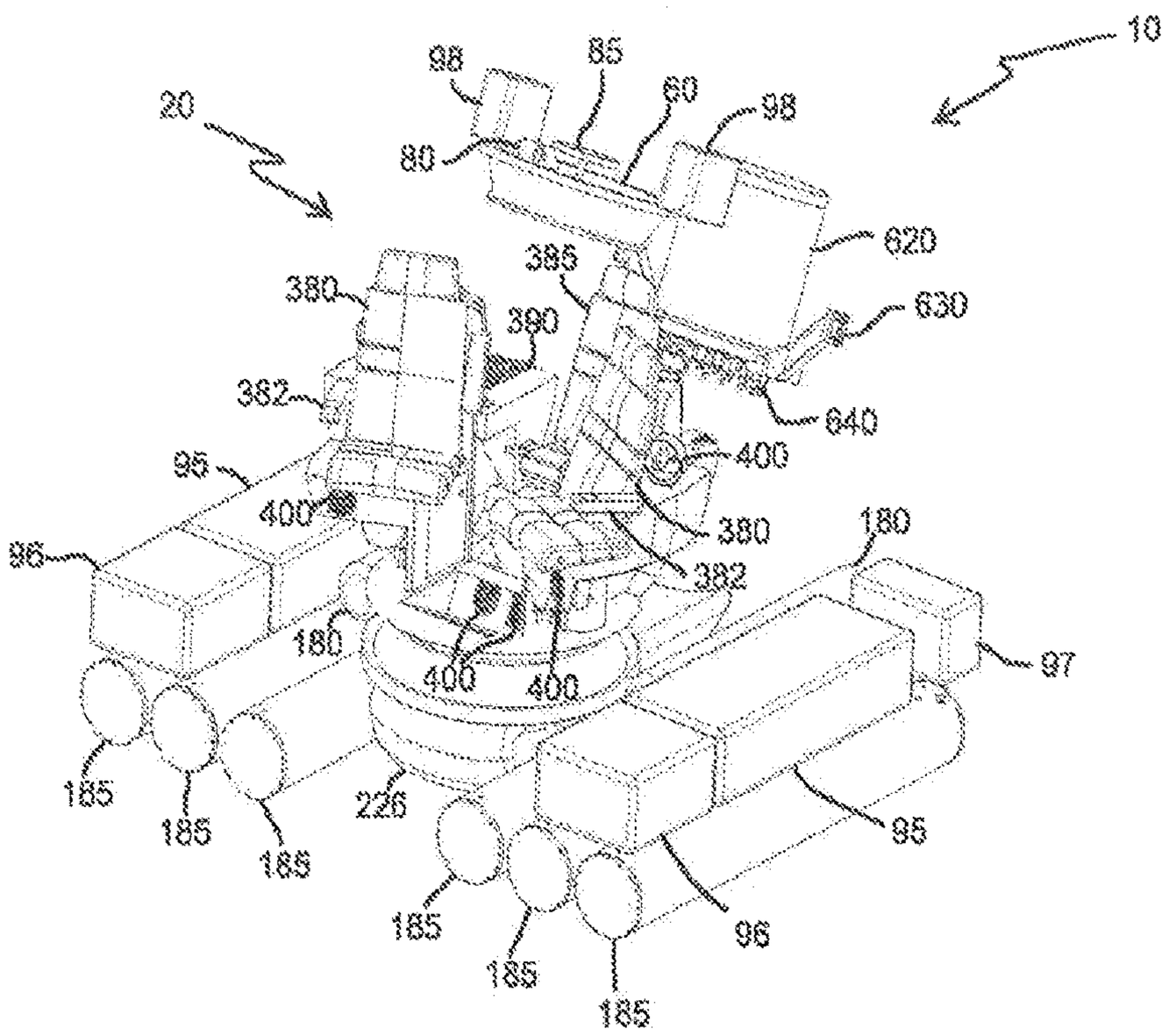
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FIG. 49

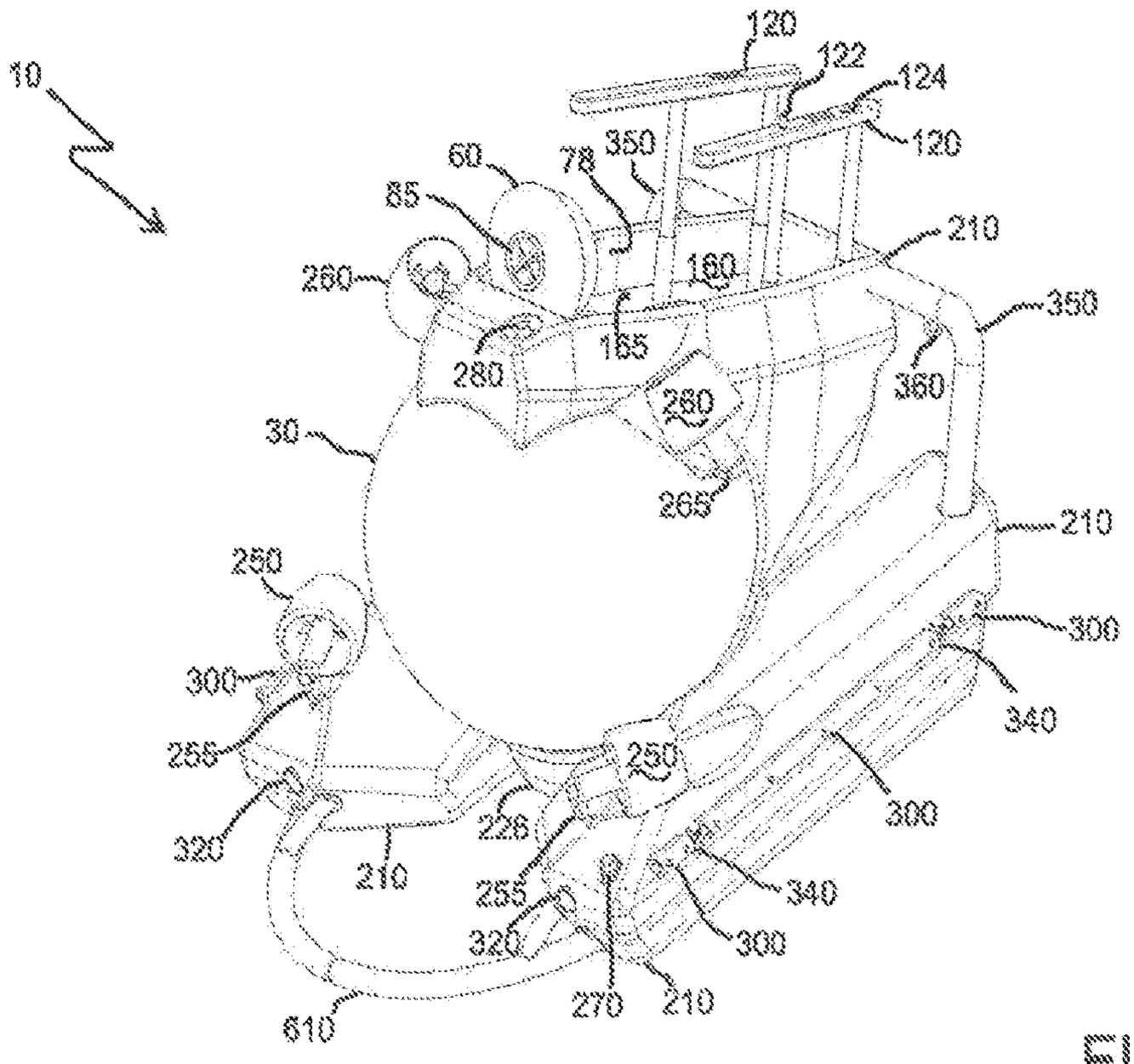
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FIG. 50

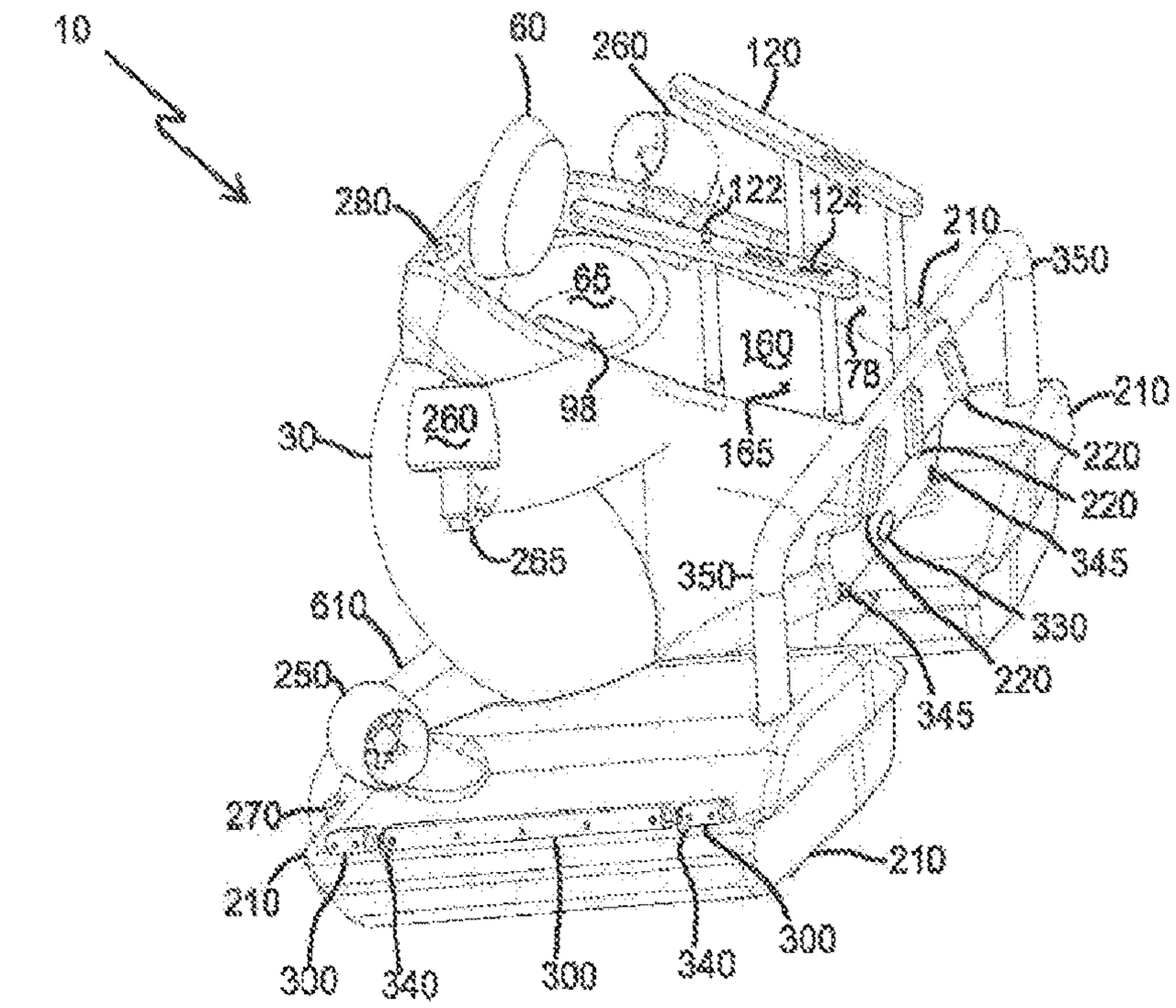
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FIG. 51

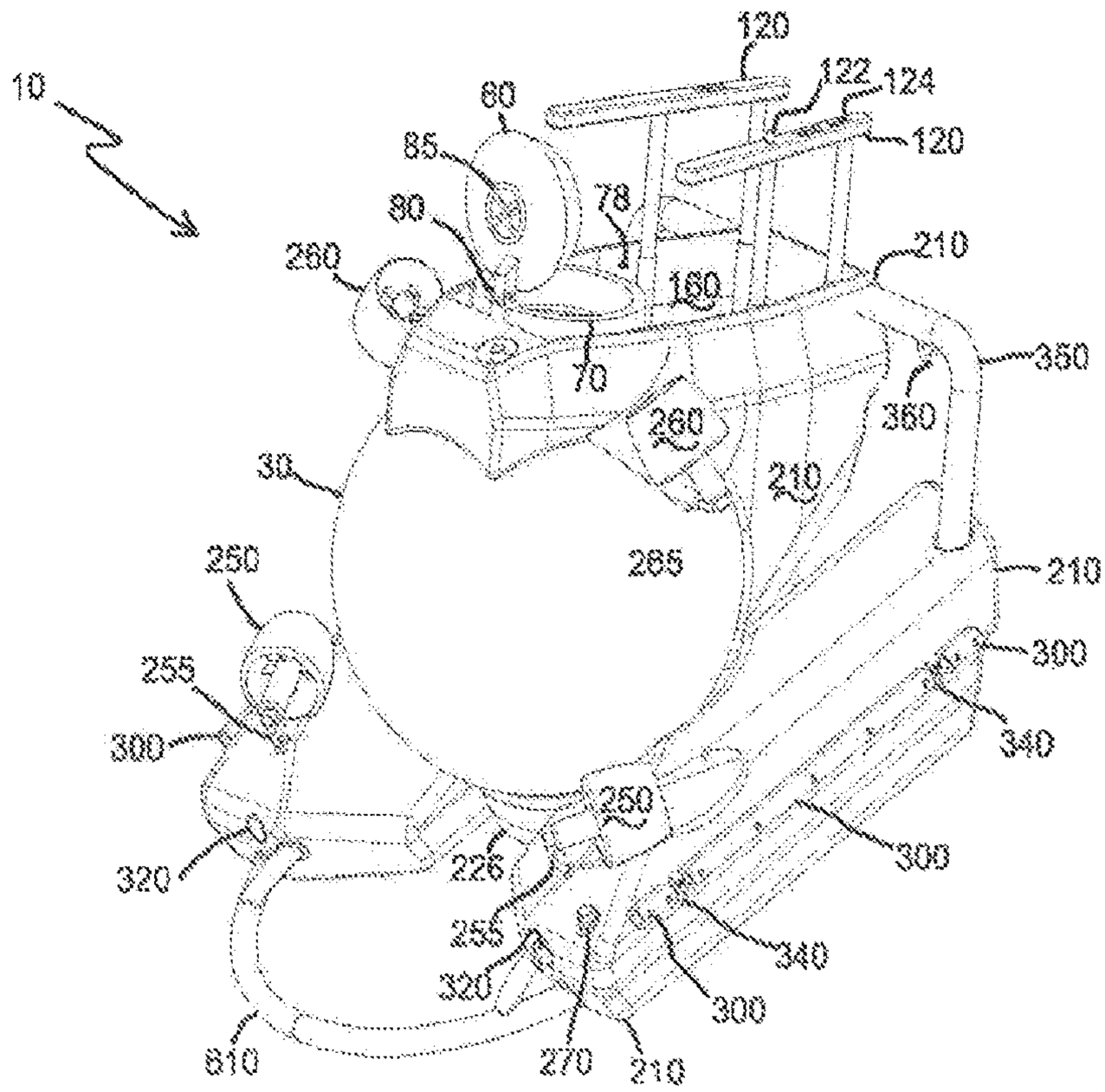
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FIG. 52

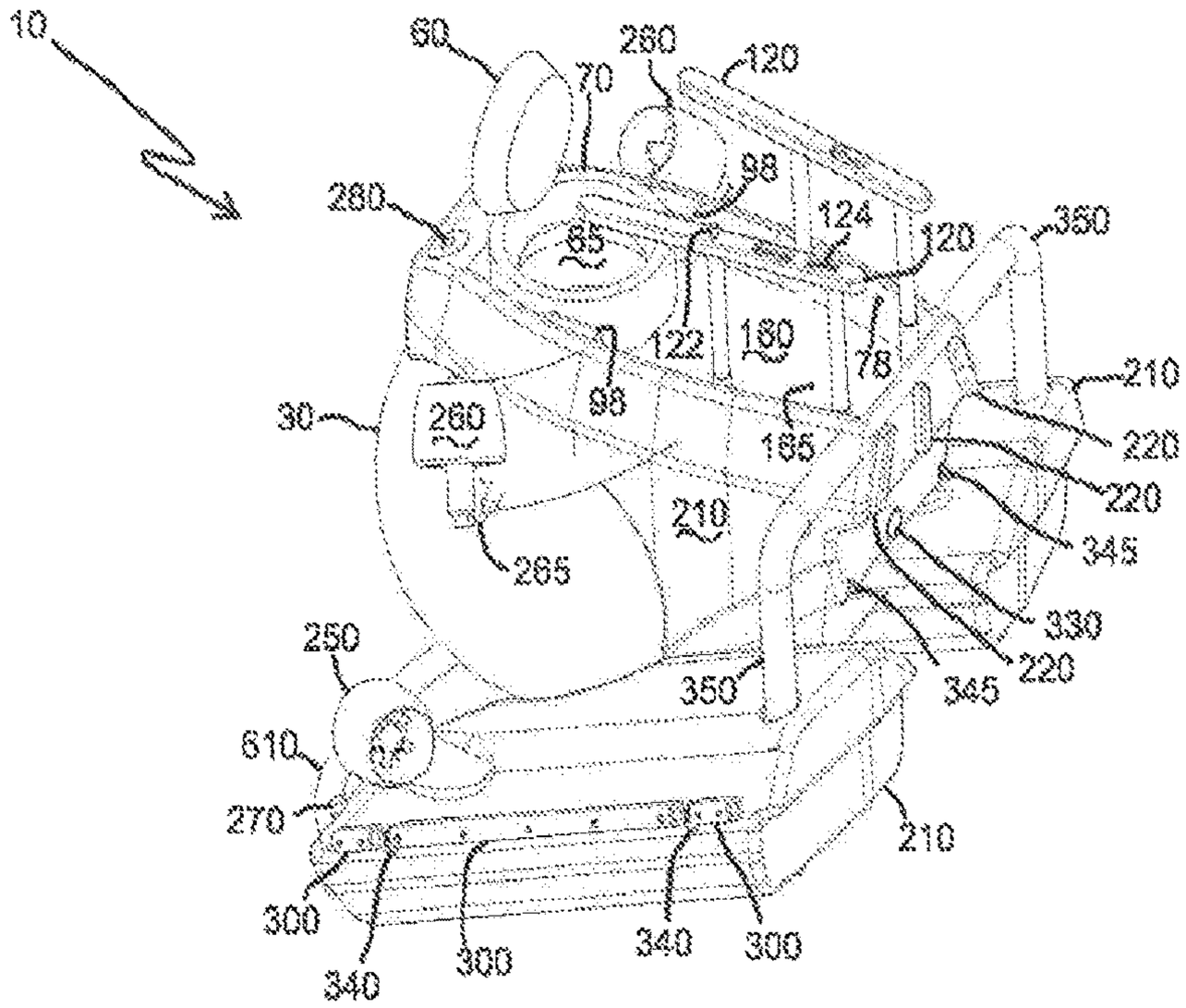
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FIG. 53

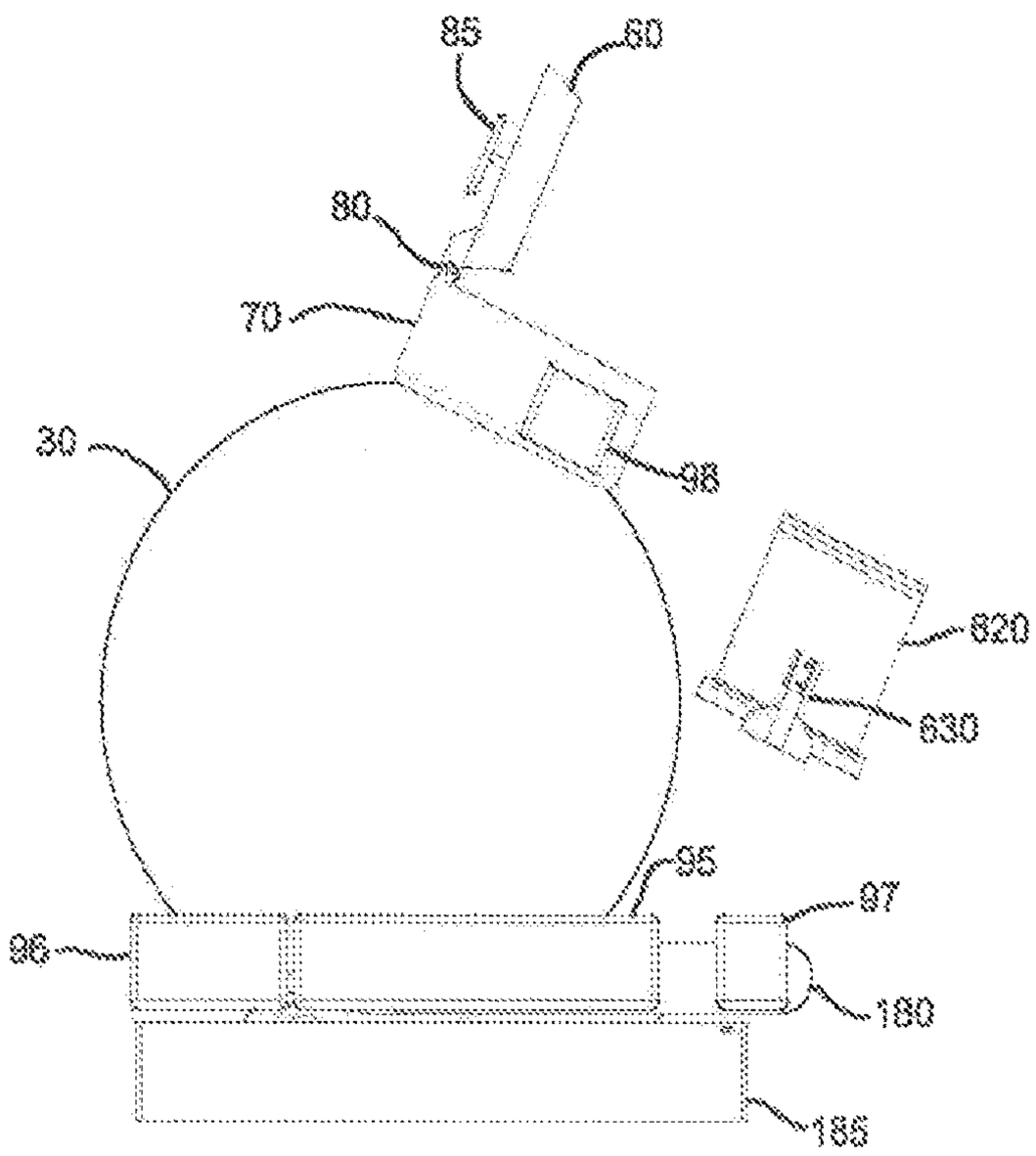
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FIG. 54

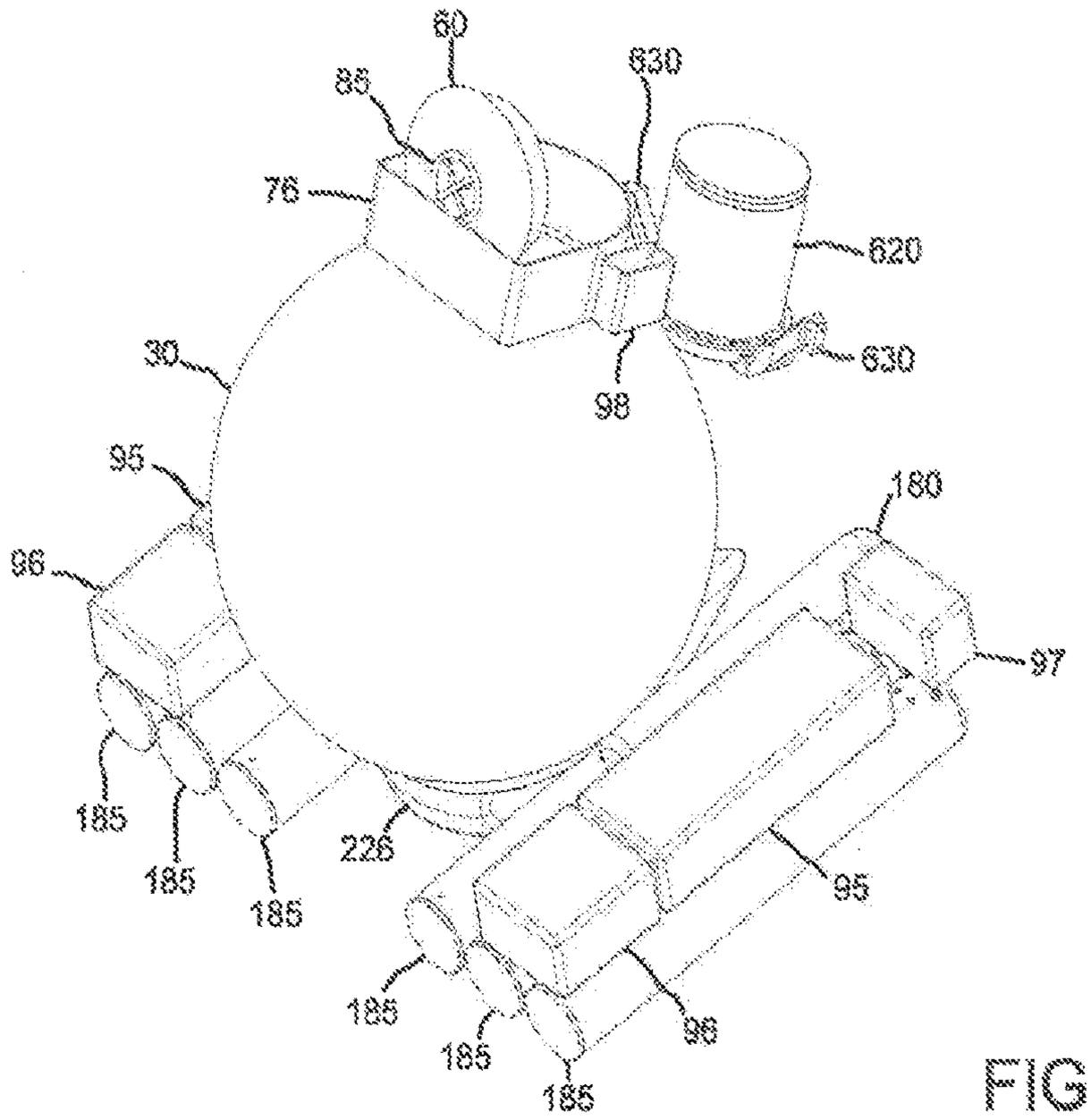
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FIG. 55

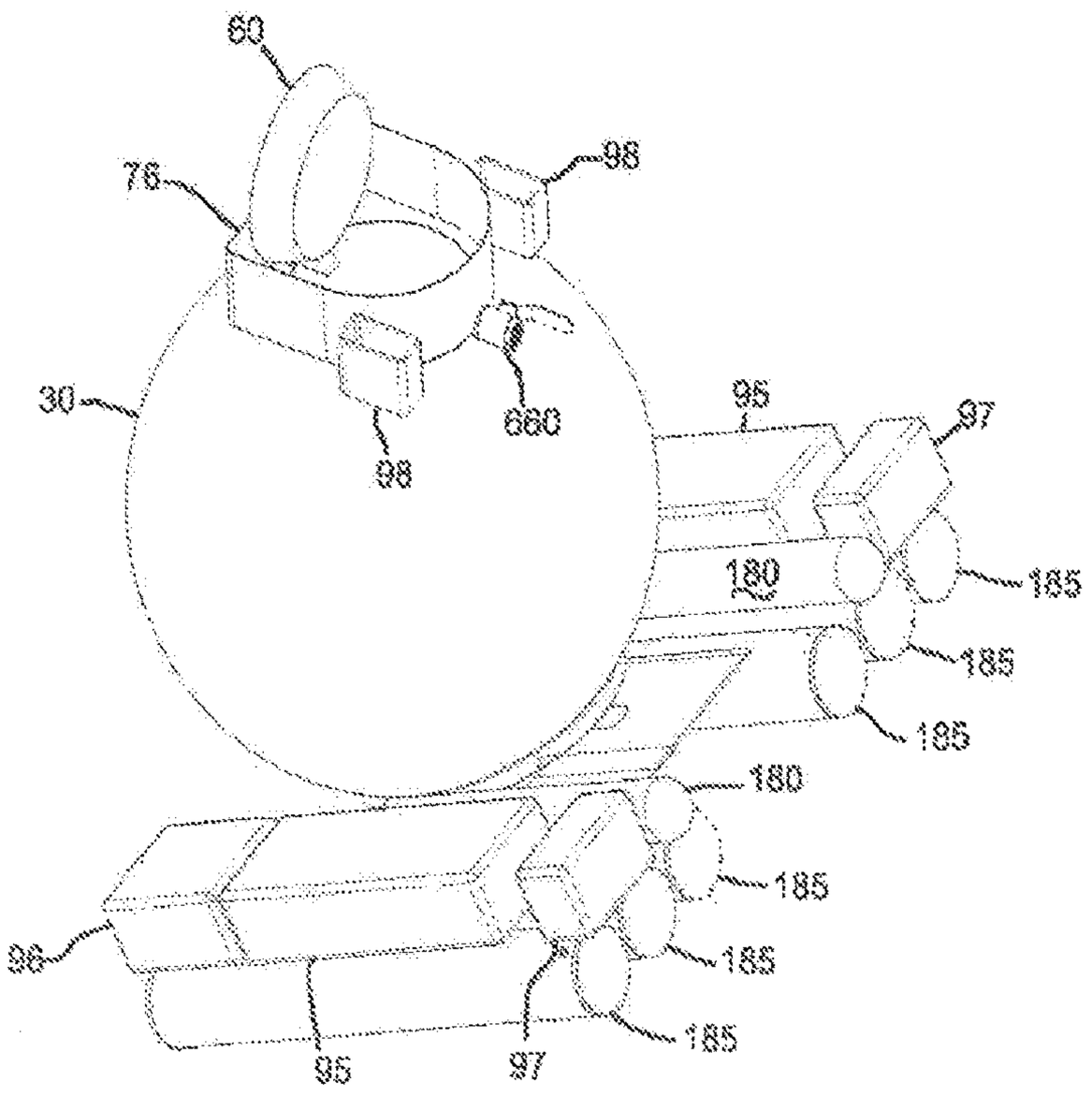
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FIG. 56

UNDERWATER WATERCRAFT

This application has priority to U.S. Patent Application No. 61/877,282, filed Sep. 12, 2013 and titled, "Underwater Watercraft", and to U.S. Patent Application No. 61/937,230, filed Feb. 7, 2014 and titled, "Underwater Watercraft", both of which are referred to and incorporated herein in their entireties.

FIELD OF THE DISCLOSURE

The disclosure that follows relates to a high visibility underwater watercraft for scientific and recreational touring.

BACKGROUND

Various forms of underwater watercraft for recreational, exploratory and scientific use are known. Various arrangements of the known craft are known relating to providing a rider compartment and ingress/egress opening. Examples of such underwater craft are provided in U.S. Pat. Nos. 4,938,164, 5,704,309 and 6,321,676.

Some known underwater craft have a passenger compartment including a transparent sphere, in which a portion of the sphere is hinged, enabling ingress and egress. In such an arrangement, a ring seal may be provided, providing a fluid blocking seal between the exterior and interior of the compartment. Such a seal although low profile, can block a portion of the field of view from the interior of the compartment. For example, in one such arrangement, the ring seal is positioned approximately at an equatorial location on the compartment sphere. In another arrangement, such as in the Remora 2000 underwater watercraft from Comex, and the Triton 1000/3 craft from Triton LLC, a hatch is provided at a top end of the passenger compartment, blocking an upward portion of the field of view.

In another arrangement, such as in the Alicia craft, a spherical passenger compartment is provided, with the hatch positioned behind the spherical portion of the compartment. Such an arrangement avoids a view blocking seal, but also increases the size of the vehicle in a portion behind the seal in order to position the hatch.

It often is desired to load or unload passengers from an underwater craft while the craft is floating at the water surface, and to have the hatch above the surface so water does not flow into the interior while the hatch is open—as opposed to lifting the vehicle out of the water, such as using a crane. Various known craft, including those described above, retain a similar attitude on the surface as they do underwater, i.e. horizontal. In such known craft, ballast tanks are filled with air via pressurized tanks, to increase their buoyancy and retain the vehicle on the surface. In one such large watercraft, the Atlantis, the ballast tanks are positioned above the pressure hull where the occupants sit, affording stability.

Known single sphere submersibles have their center of gravity and center of buoyancy aligned along a vertical centerline of the sphere, aligning a hatch or ingress/egress opening with them. For surfacing where access is through a top hatch, to ensure that the submersible is in the similar horizontal attitude at surface as it is under water, the surface buoyancy would be spaced generally evenly in front and behind of the spherical cabin, for example in pontoons along either side, and usually at or below the horizontal centerline of the sphere. Likewise, heavy items, such as battery pods, are usually similarly equally placed in front of and behind the vertical centerline of the sphere. Positioning of the hatch or ingress/egress apparatus on or vertically above the passenger cabin has a disadvantage or reducing the field of view from the passenger cabin.

Accordingly, there is a need for an underwater craft having a wide or generally unobstructed forward, sideways and upwards field of view, providing an ingress and egress hatch to the exterior that is positioned out of the field off view, and also provides surface stability for ingress and egress, in addition to a reduced footprint enabling storage on smaller vessels and transport on smaller trailers.

SUMMARY

The present disclosure, in its many embodiments, alleviates to a great extent the disadvantages of known underwater watercraft by providing a generally spherical and transparent passenger compartment with an ingress/egress hatch positioned in a mounting frame to the rear of the passenger compartment, or to a generally spherical passenger compartment.

In one embodiment, a passenger compartment includes a clear portion affording the occupants a view of the outside, and attached to it, a pressure hull or pressure vessel providing an ingress/egress port. In one embodiment, the clear portion of the passenger compartment is made of a portion of a sphere, made of an acrylic or other largely transparent material. Of course any shape can be used that affords a view of the exterior. Attached to the clear portion is the optional access pressure vessel, via a fluid-tight seal or connection. The access pressure vessel includes a port or access hatch providing an entry or exit for the occupants.

In an embodiment the watercraft has an angled surface mode and horizontal submerged mode; buoyancy elements such as ballast are applied to effectuate surfacing, such as by evacuating water from ballast elements, thereby increasing buoyancy. The ballast elements are positioned such that in a buoyant state (i.e. water evacuated), the center of buoyancy is moved towards the rear of the watercraft as buoyancy is increased. In such an embodiment, the center buoyant force applied by the ballast is posterior to the location of the center of gravity. When in water, the center of gravity will maintain at a point at or vertically below the center of buoyancy (generally in line with the direction of the Earth's gravitational force), and since the center of gravity remains generally fixed, the attitude of the watercraft changes depending upon the center of buoyancy. As the center of buoyancy moves to the rear the attitude of the watercraft also changes, assuming a tail angled up attitude, generally maintaining the center of buoyancy vertically above the center of gravity. For example, when at the surface, or at some instances of surfacing, the center of buoyancy is positioned posterior to its location in an operation mode under the surface. At the water surface, when the watercraft is in position for ingress or egress, the opening of the hatch extends above the surface. In such a position, water inflow is reduced or eliminated. In an example, the opening defines a circle or other shape in a plane generally parallel to the surface, with buoyancy elements maintaining the watercraft in a position such that the opening is above the surface. In such an embodiment, when the watercraft is submerged, the plane of the opening of the hatch is at an angle with respect to the water surface.

The buoyancy elements can be any type of buoyant material or structure that maintains the watercraft at the surface when desired. In an example, longitudinally extending pontoons or ballast tanks are provided, along with optional trim ballast tanks and optional trim weight(s). If a

construction is selected in which the tanks are maintained in a plane generally parallel to the surface, the access hatch opening can be selected to be in the same orientation. In an embodiment in which the watercraft assumes a tail elevated attitude at the surface, the access hatch opening can be selected to be generally parallel to the surface and at an angle with respect to the buoyancy elements or with respect to the horizontal plane when the vehicle is in an operation mode. In an embodiment, the center of gravity and buoyancy elements are positioned such that the buoyancy elements and/or passenger seats are generally horizontal (i.e. perpendicular to the direction of the Earth's gravitational pull) or generally parallel to the surface such as in general operation of the watercraft under the surface, and the passenger seats and buoyancy elements are at an acute angle other than parallel to the surface (or perpendicular to the direction of gravity) when at the surface, and the opening of the access hatch is generally parallel to the surface. The attitude of the watercraft may be adjusted by any combination of weights, or buoyancy elements, or other arrangement of components of the watercraft.

In an alternative embodiment, a generally tail elevated attitude in a surface or surfacing mode is achieved by moving the center of gravity (and center of buoyancy) of the vehicle, such as by application of a movable trim weight, or alternatively or additionally using trim ballast tanks. In one embodiment with a movable trim weight, the trim weight is movably mounted to the watercraft, such as in a position beneath elements of the watercraft, such that the weight can be moved forward and backwards in the craft. As the trim weight is moved from front towards rear, the center of gravity of the watercraft also moves from front towards rear. In a tail elevated mode, the trim weight is positioned more towards the front of the watercraft than in a horizontal operation mode. The trim weight may be composed of heavy components of the vehicle, for example the batteries and/or battery pods, mounted on a moveable rack or other assembly to move the components.

In an alternative embodiment, trim ballast tanks may be used to adjust the attitude of the watercraft. For example, front and rear trim ballast tanks are provided and are evacuated using air to achieve a desired level of buoyancy and attitude angle. Likewise, a combination of trim ballast tanks and movable trim weight(s) may be used to determine a desired vehicle attitude.

In an embodiment where the watercraft assumes the generally tail elevated or angled attitude in a surface mode, the buoyancy ballast elements can be positioned anterior to the main passenger compartment corresponding to the partial sphere, although any other positioning of the weight of different vehicle elements and/or ballast may be selected in alternative embodiments.

In an alternate embodiment a passenger compartment is formed with a generally spherical and clear enclosure, although any shape can be used that affords a view of the exterior, and all or a portion of the enclosure may be clear. The compartment has an ingress/egress port or access hatch positioned to the rear of seats, or in such a way that it is out of the normal field of view of occupants positioned on the seats. Optionally a riser is either fixedly or removably attached around the hatch via a fluid tight seal or connection, elevating the effective ingress/egress elevation of the hatch opening above the water surface.

Accordingly, it is seen that a reduced footprint underwater watercraft is provided, with improved visibility from a passenger compartment, and an optional tail angled up orientation in a surface or surfacing mode of operation, in which the angle of a hatch opening is set depending upon the expected angle in the surfacing mode.

Other objects and advantages of the present invention will become more evident hereinafter in the specification and drawings that follow.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects of the disclosure will be apparent upon consideration of the following detailed description, taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a front perspective view of an underwater watercraft in accordance with the present invention;

FIG. **2** is a port side plan view of an underwater watercraft in accordance with the present invention;

FIG. **3** is a starboard side plan view of an underwater watercraft in accordance with the present invention;

FIG. **4** is a top plan view of an underwater watercraft in accordance with the present invention;

FIG. **5** is a bottom plan view of an underwater watercraft in accordance with the present invention;

FIG. **6** is a front plan view of an underwater watercraft in accordance with the present invention;

FIG. **7** is a rear plan view of an underwater watercraft in accordance with the present invention;

FIG. **8** is a port side view of a portion of an underwater watercraft in accordance with the present invention;

FIG. **9** is a cross-sectional port side view of a portion of an underwater watercraft in accordance with the present invention taken along A-A of FIG. **7**;

FIG. **10** is a front perspective view of a portion of an underwater watercraft and the interior of the passenger compartment in accordance with the present invention;

FIG. **11** is a perspective view of a passenger compartment in accordance with the present invention;

FIG. **12** is a front perspective view of components of an embodiment of an underwater watercraft in accordance with the present invention;

FIG. **13** is a side view of the components of an underwater watercraft of FIG. **12**;

FIG. **14** is a front view of the components of an underwater watercraft of FIG. **12**;

FIG. **15** is a rear view of the components of an underwater watercraft of FIG. **12**;

FIG. **16** is a bottom view of the components of an underwater watercraft of FIG. **12**;

FIG. **17** is a front perspective view of components of the underwater watercraft in accordance with the present invention;

FIG. **18** is a perspective view of an elongated embodiment of an underwater watercraft in accordance with the present invention;

FIG. **19** is a perspective view of an underwater watercraft in accordance with the present invention situated at a water surface with an example of a tender craft;

FIG. **20** is a perspective view of an underwater watercraft in accordance with the present invention situated at a water surface with an example of a tender craft;

FIG. **21** is a side view of an underwater watercraft in accordance with the present invention situated at a water surface with an example of a tender craft;

FIG. **22** is a cross-sectional port side view of an underwater watercraft in accordance with the present invention taken along A-A of FIG. **7**, and situated at a water surface;

FIG. **23** is a cross-sectional perspective view of components of an underwater watercraft in accordance with the present invention;

FIG. **24** is a port side view of an underwater watercraft descending below a water surface in accordance with the present invention;

FIG. **25** is front perspective view of components of an embodiment of an underwater watercraft in accordance with the present invention;

FIG. **26** is a side view of the components of an underwater watercraft of FIG. **25**;

FIG. **27** is a front view of the components of an underwater watercraft of FIG. **25**;

FIG. **28** is a rear view of the components of an underwater watercraft of FIG. **25**;

FIG. **29** is a top view of the components of an underwater watercraft of FIG. **25**;

FIG. **30** is a bottom view of the components of an underwater watercraft of FIG. **25**.

FIG. **31** is a bottom view of an underwater watercraft in accordance with the present invention with a partial cutaway showing internal components.

FIG. **32** is a perspective view of the underwater watercraft of FIG. **31**.

FIG. **33** is a perspective view of components of the underwater watercraft of FIG. **31**.

FIG. **34** is a bottom view of components of the underwater watercraft of FIG. **31**.

FIG. **35** is a rear perspective view of an underwater craft in accordance with the present invention.

FIG. **36** is a rear perspective view of an underwater craft in accordance with the present invention.

FIG. **37** is a rear perspective view of components of an embodiment of an underwater craft in FIG. **35**.

FIG. **38** is a rear perspective view of components of an embodiment of an underwater craft in FIG. **35**.

FIG. **39** is a side view of components of an embodiment of an underwater craft in FIG. **35**.

FIG. **40** is a front perspective view of an underwater craft in accordance with the present invention.

FIG. **41** is a rear plan view of an underwater craft in accordance with the present invention.

FIG. **42** is a front perspective view of an underwater craft in accordance with the present invention.

FIG. **43** is a cross sectional side view of an underwater craft in accordance with the present invention.

FIG. **44** is a cross sectional side view of an underwater craft in accordance with the present invention, situated at the water surface.

FIG. **45** is a cross sectional side view of an underwater craft in accordance with the present invention, situated at the water surface.

FIG. **46** is a port side view of components of an embodiment of an underwater craft in FIG. **40**

FIG. **47** is a front perspective view of components of an embodiment of an underwater craft in FIG. **40**.

FIG. **48** is a front perspective view of the interior of the passenger compartment and components of an embodiment of an underwater craft in FIG. **40**.

FIG. **49** is a front perspective view of components of an embodiment of an underwater craft in FIG. **40**.

FIG. **50** is a front perspective view of an underwater craft in accordance with the present invention.

FIG. **51** is a rear perspective view of an underwater craft in accordance with the present invention.

FIG. **52** is a front perspective view of an underwater craft in accordance with the present invention.

FIG. **53** is a rear perspective view of an underwater craft in accordance with the present invention.

FIG. **54** is a port side view of components of an embodiment of an underwater craft in FIG. **52**

FIG. **55** is a front perspective view of components of an embodiment of an underwater craft in in accordance with the present invention.

FIG. **56** is a rear perspective view of components of an embodiment of an underwater craft in in accordance with the present invention.

DETAILED DESCRIPTION

In the following paragraphs, embodiments will be described in detail by way of example with reference to the accompanying drawings, which are not drawn to scale, and the illustrated components are not necessarily drawn proportionately to one another. Throughout this description, the embodiments and examples shown should be considered as exemplars, rather than as limitations of the present disclosure. As used herein, the "present disclosure" or "present invention" refer to any one of the embodiments described herein, and any equivalents. Furthermore, reference to various aspects of the invention throughout this document does not mean that all claimed embodiments or methods must include the referenced aspects or features.

FIG. **1** provides a perspective view of an embodiment of an underwater watercraft **10** in accordance with the present invention. Any shape or size of watercraft may be selected, and the figures illustrate one such embodiment. The components of the watercraft are now described. A passenger compartment **20** (the interior of which is shown in FIGS. **9** and **10**, for example) is provided, such as partially enclosed within partial sphere **30**. Partial sphere **30** is constructed of a transparent acrylic material although any material providing a desired structural strength sufficient to withstand submerged environmental pressures and maintain a fluid sealed environment may be used. Although a spherical shape is illustrated for this embodiment, it is noted that any shape for the viewing area or passenger compartment **20** may be provided.

Access portion **40** is provided posterior to the partial sphere **30**, and a fluid or water tight seal between the two is formed. The access portion **40** is alternatively referred to as an access pressure vessel **40** in this description. An ingress/egress port **50** (for example as labeled in FIG. **8**) is formed towards an upper portion of the access pressure vessel **40**. The port **50** includes an access hatch **60** positioned on a riser **70**, and linked thereto, such as using a hinge **80**. Of course it is understood that the hatch **60** may be positioned at any location such that in the surface state of the watercraft **10**, the hatch and/or riser **70** opening is above the waterline **200**. One or more optional latch handle **85** can be provided as well to assist with opening the hatch **60** from the exterior of the watercraft **10**. The riser can provide any desired length of separation between a lower portion of the access pressure vessel **40** and the hatch **60**. In one example, a relatively long riser **70** is used to obtain a greater elevation of the hatch **60** when at the surface, reducing the amount of surface ballast required. Likewise, the use of the pressure vessel **40** with riser **70** enables for the hatch **60** to be moved away from the top of the sphere **30**, and also from the portion of the passenger compartment **20** formed within the pressure vessel **40**. For example in the illustrated embodiments, a portion of the passenger compartment is formed within anterior a rear portion **90** of the pressure vessel **40**. Although an access pressure vessel **40** is provided in the illustrated embodi-

ments, it should be understood that it is an optional feature, and the ingress/egress port(s) of the vehicle **10** may be provided on any other portion providing access to the interior.

In the illustrated example, the access pressure vessel **40** is constructed of a metallic material, although any desired material can be selected. The rear portion **90** includes a half sphere, but also can be of any desired shape. The half sphere of the rear portion **90** is smaller in diameter than the passenger compartment sphere **30**, which has an advantage of requiring smaller lower ballast tanks **95** as compared to a construction in which the rear portion **90** is larger than partial sphere **30**.

The opening **65** defined by the access hatch **60** is positioned on the rear portion **90** in the illustrated example at an angle relative to the plane of the water surface **200** when submerging or submerged. In the illustrated example, the riser **70** is cylindrical, defining a circular opening **65**. However, any desired shape for riser **70** and opening **65** may be selected. Generally speaking, the longer the riser **70**, the less surface ballast is required, but the higher the overall height of the watercraft **10** is in storage. By putting riser **70** at an angle **75** (illustrated in FIG. **13**, for example), its length can be maximized while still retaining a lower overall height for the submersible when in storage or on the deck of a support ship. Although the optional riser **70** at an angle provides improved freeboard access at surface, it is understood that the access opening **60** may be positioned without a riser.

In an example, the riser **70** is positioned to extend to a height that is at, or close to a plane at the top of the watercraft **10**. An example of the plane location is provided with reference number **130**. This design feature can further reduce the height profile of the vehicle **10** in that the protrusion hatch **60** above the body of the watercraft **10** can be reduced or eliminated depending up on a design selected.

In operation, the hatch **60** may open to a side and lock in place serving as a hand rail for passengers entering or exiting the watercraft **10**. In the illustrated embodiment, the hatch opens forward and out of the way and two optional retractable hand rails **120** are provided. An illustration of the handrails extended is provided in FIGS. **20** and **23**. A handrail retraction/extension linkage optionally may be provided to link extension of the handrails **120** with opening of the hatch **60**. Alternatively, an electronic control may be provided that triggers extension of the handrails **120** when the hatch **20** is opened and retraction on a closing actuation signal. In alternative embodiments, foldable, fixed or removable hand rails **120** are provided. The handrails **120** also can include optional strobe **122** and vehicle controls **124**. These elements **122** and **124** also may be positioned at other locations on the craft **10**.

The hatch assembly also optionally includes a skirt **140** positioned on an extendible riser **150**. In operation, the opening of the hatch **60** allows for extension of the extendible riser **150**. Alternatively, the riser **150** is fixed in place. In an alternate embodiment, a portion of the waterproof skirt **140** is connected around only a portion of the riser **150** and the remainder of is formed on the sealing surface **63** of the hatch **60**. In another embodiment, the waterproof skirt **140** is formed entirely on the sealing surface **63** of the hatch. It should be understood that any seal that forms a fluid-tight seal can be used, and in some embodiments, neither a skirt **140** nor a riser **150** is used. An advantage of using an extendible riser **150** (or a fixed extended riser **150**) is that in effect the hatch opening **65** is extended above the watercraft **10**, which has advantages of reducing water entry, such as in rough weather.

Various arrangements of ballast tanks may be provided for promotion of dive level, and surface stability. In the illustrated embodiment, both lower ballast tanks **95** and optional upper ballast tanks **160** are provided. At the surface, the lower ballast tanks **95** (also referred to as pontoon tanks) may be selected to stay at a submerged or partially submerged position. The upper ballast tanks **160** optionally may have a flat upper surface **165** assisting with passenger access to the hatch **60**. The upper ballast tanks **160** optionally as well may be submerged or partially submerged when the watercraft **10** is at the surface. Alternatively, as illustrated in FIGS. **50-53**, the upper ballast **160** is open, like a boat interior, with the water either draining out or being pumped out at the surface, and when submerged it fills on its own. In this alternate embodiment, flat surface **165** is at the base of ballast **160** rather than at the top surface as in the closed embodiment. The use of upper and lower ballast tanks **95**, **160** in combination serves to promote surface stability while also promoting downward visibility from the passenger compartment **20** by having the lower ballast tanks size reduced so as to be positioned out of or in a reduced portion of the field of view.

In the illustrated embodiments, the watercraft **10** has a generally angled surface mode and less angled, or generally horizontal submerged mode of operation. Examples of the angled surface mode are illustrated, in FIGS. **19-23**. Examples of the less angled or horizontal mode of operation are illustrated in FIGS. **1-10** and **24**. Depending upon the application of various ballast tanks (such as surface ballast **95**, upper ballast **160** and trim ballast **96**, **97**) or trim weight(s) (illustrated within trim weight enclosures **98**, **225**; "trim weights" and "trim weight enclosures" will be referred to herein with reference numbers **98** and **225**, collectively) or combinations of various ballast **95**, **96**, **97**, **160** and trim weight(s) **98**, **225** the angular orientation of the watercraft **10** is determined. In these examples, application of ballast and/or application of or movement of the trim weight(s) determines the attitude of the watercraft **10**. Although these specific elements are referred to as trim weights in the illustrated embodiments, it should be understood that any element of the watercraft **10** may serve as a trim weighting element, such as any components of the vehicle having sufficient mass, such as the batteries and/or battery pods, mounted on a moveable rack or other assembly to move the components.

In one example of a submerged mode, the watercraft **10** operates in the generally horizontal attitude. Ballast tanks **95**, also referred to as pontoon surface ballast tanks **95**, and optional upper ballast tank (s) **160** are completely filled with water and provide no additional buoyancy, except to the extent a buoyant material may be used for construction of the tanks, although a non-buoyant material also may be selected. In operation in a surfaced mode the pontoon surface ballast tanks **95** and optional upper ballast tank(s) **160** are partially or fully evacuated of water in order to rise towards or have stability at the surface **200** of the water. In one operational embodiment, when the watercraft **10** is at the surface, the evacuation of the ballast **95**, **160** serves to provide a stable platform for embarking/disembarking.

When evacuated of water, the combined displacement of the trim ballast tanks (front **96** and rear **97**) optionally may be selected to equal or approximate the maximum payload of the watercraft **10**. If the maximum payload of personnel/equipment is loaded in operation, then the trim tanks **96**, **97**

can be fully evacuated of water (such as filled with air) to provide additional buoyancy to maintain the watercraft **10** at a desired surface buoyancy. For payloads in between the maximum and minimum, the ratio of air/water inside the trim tanks **96**, **97** is adjusted to keep the watercraft **10** at the desired level of buoyancy. It may be desired to keep the watercraft **10** always positively buoyant and use the vertical thrusters **260** to move up and down, or adjust the buoyancy as desired, such as to provide negative buoyancy for descent and positive buoyancy for ascent.

By increasing the air to water ratio in the rear trim ballast tanks **97** and/or reducing the air to water ratio it in the front trim ballast tanks **96**, the desired buoyancy can be maintained, but the attitude of the watercraft **10** can be altered, such as adopting a greater tail up attitude in a surface mode of operation. In the surface mode, the front and rear trim tanks **96**, **97** will be predominantly evacuated of water, but may be adjusted to obtain the desired angle of the watercraft **10** for loading or unloading.

In one example, the rear trim ballast tank **97** is twice as far away from the center of gravity as the front trim ballast tank **96**. In such an embodiment, it only requires to be half the size of the front trim ballast tank to have the same effect on the angle.

To reduce the size of trim ballast tanks **96**, **97** in alternate embodiments, the payload can be made approximately constant on every dive by adding trim weights **99** (such as lead filled bags) in displacement trim weight enclosures **98**. Although the displacement trim weight enclosures **98** are illustrated on riser **70**, close to hatch **60**, it should be appreciated that the enclosures can be positioned at any location on the watercraft **10** that can receive the weights **99**. For example by way of illustration, if the maximum payload of the watercraft **10** is 700 lbs., and the occupants plus equipment weigh 600 lbs., then 100 lbs. of lead bags **99** may be mounted in enclosures **98** to achieve the maximum payload of 700 lbs. The trim ballast tanks **96**, **97** then only need to be the required size to adjust the angle of the watercraft **10**, such as for example to be around horizontal underwater, or perhaps nose down (or up) for descending, and nose up (or down) for ascending if desired. The trim ballast tanks **96**, **97** would also be used to make slight changes in buoyancy of the vessel **10** to allow for ascent, descent or neutral buoyancy as desired.

The angle trim weight(s) **225** can be used in addition to, or as an alternative for trim tanks, such as the front and rear trim tanks **96**, **97**, and can be used for adjusting attitude of the watercraft **10**. In this embodiment, the angle trim weight **225** is positioned within an optional trim weight enclosure **226**. The trim weight **225** is movable, such as forward or backward, and the position desired can change the attitude. In one example the trim weight **225** is movable along a rotatable adjusting screw **227**. Any desired control for rotating the adjusting screw **227** can be selected, such as electric, hydraulic and/or manual. Trim weight also optionally is mounted on guide rails **228**. The trim weight assembly (including for example weight **225**, screw **227** and rails **228**) is illustrated in FIGS. **31-34** in a cutaway within the optional enclosure **226**, for purposes of illustration only. It should be understood that although in one embodiment the enclosure **226** could have an opening, generally speaking it is most desired for the enclosure **226** to enclose the trim weight assembly components, although an optional door or hatch can be provided to provide interior access.

In an alternate embodiment, the trim weight enclosure **226** is movable along with the trim weight. In an embodiment in which the enclosure **226** is movable, and lights **335**, or DVL **285** are mounted on it, then those components would move as well when the enclosure **226** is moved.

The trim ballast tanks **96**, **97** can be used in such an embodiment to supplement the attitude adjustment, or alternatively solely to adjust the overall buoyancy of the vessel **10**, or alternatively no trim ballast tanks **96**, **97** are provided. Likewise, either or a combination of the angle trim weight **225** and/or trim ballast tanks **96**, **97** can be used to maintain the watercraft **10** at the angle desired for hoisting, such as via grappling the craft **10** via the hoist point **125**.

In one embodiment, the angled surface mode, the ballast **95**, **96**, **97** and/or trim weight(s) **98**, **225** are regulated such that the watercraft **10** has a generally tail angled up attitude, and in submerged mode has a generally horizontal attitude. In an example of the horizontal mode, the center of gravity (CG) of the watercraft **10** is indicated by reference number **100** and the center of buoyancy (CB) is indicated with reference number **105**, when operating in the generally horizontal mode. In this example, the center of buoyancy **105** is illustrated as being vertically above the center of gravity **100** and below the centerline **170**, although in alternative embodiments the CB **105** and CG **100** may be at different locations. For example in another embodiment, the CB **105** is above the centerline. An imaginary line **107** between the CG **100** and CB (**105** or **110**) is in the direction of the Earth's gravitational pull, and in a horizontal mode, appears to be generally vertical.

In the surface or tail angled up mode, the center of buoyancy (CB) shifts towards the rear of the watercraft **10**. For illustration purposes such a location is indicated with reference number **110**. For indication of the relative positions of the examples of the positions of CB **105** and **110** are indicated in FIG. **8**. However, it should be understood that at any one time, the watercraft **10** has only a single center of buoyancy as understood in principals of physics. In the example illustrated in FIG. **8**, the tail angled up mode center of buoyancy **110** is illustrated as being below the centerline **170**, although in alternative embodiments the CB **110** and CG **100** may be at different locations. For example in another embodiment, the CB **110** is above the centerline. Depending upon an attitude angle desired, the center of buoyancy (CB) is shifted such as by applying ballast. For example, if a slight tail up attitude is desired, the CB is positioned slightly posterior to the CG. If a greater tail up attitude (greater angle) is desired, then the CB is adjusted to be positioned further to the rear of the CG. This motion towards the rear is effectuated by operation of the ballast tanks **95**, **96**, and/or **97** order to achieve a desired angle. In such an embodiment, the center of buoyant force resulting from evacuation of ballast tanks can be located as desired.

Positioning the CB in surface mode **110** to the rear of its position **105** where it is in submerged mode provides different advantages, such as, for example but not by way of limitation, improving forward or upward visibility out the clear structure **30**, and allowing other components and ballast tanks to be positioned posterior to the front of the cabin **30**. Likewise, an optional single-point hoist point **125** can be provided at a position that is generally to the rear of the viewing area of the passenger cabin **20**, so as not to restrict, or to minimize interference with, upward visibility as viewed from within the cabin **20**. For example a combination of a partial sphere **30** and access pressure vessel **40** as discussed in these embodiments can serve to move the CB backwards towards the access pressure vessel **40** compared with using only the partial sphere **30**. This in turn allows the surface ballast tanks **95** to be positioned generally behind the desired field of view from the passenger compartment of

cabin. In addition, selecting a tail up attitude for the surface mode positions all or a large portion of sphere **30** underwater, also further enabling position of the surface ballast tanks **95** rearward. Selecting an arrangement with the tail up surface mode attitude (i.e. the CB in surface mode shifted rearward), other components such as batteries **180** can also be moved rearward enabling a design with the CG further rearward than otherwise might be possible. In different examples, as more equipment is placed further back, the CB moves further back, generally irrespective of the actual weight of that equipment. The CG of the vessel can be designed to be in an optimally desired location below the CB depending on the size and weight of the trim weight **225**, and different arrangements of trim weights may be selected. In one example a fixed trim weight is positioned forward of the CB, in addition to movable trim weight **225**.

In the illustrated embodiment, the centers of buoyancy of the ballast tanks **95** and/or **160** are positioned behind the CG **110** of the vessel **10**. The ballast tanks **95** are also positioned below the half-way line **170** of the sphere **30** (illustrated with phantom line **170**), and as such in a typical surface orientation of the vessel **10** remain submerged below the surface **200**. As the ballast in tanks **95** is inflated, such as from air from air tanks **180**, the watercraft adopts a tail elevated (also referred to as "tail up" or "angled") attitude, such as illustrated in FIG. **21**. The optional upper ballast tanks **160** are positioned adjacent the hatch **60** and riser **70**. In operation, the upper ballast tanks **160** optionally are drained using the high pressure air from air tanks **180**. Alternatively, the upper ballast tanks **160** are wholly or partially gravity drained by operation of the submerged lower ballast tanks **95**, and in the case of partial gravity draining, the last amount is drained using air supplied from the high pressure air tanks **180** via air lines. Although installation of, or operation of the upper ballast tanks **160** is optional, it is found that their use can increase surface stability. By utilizing a gravity drain system, the amount of air required to be supplied by the air tanks **180** may be reduced, increasing the air tank **180** fill cycle.

An optional housing **210** may be provided enclosing various operational components of the watercraft **10**. For example, the housing **210** may enclose the ballast tanks **95**, **160** and hatch assembly **50**, for aesthetic and/or functional purposes. One functional purpose of the housing **210** may be to reduce drag in operation, thereby serving to increase operational time between refueling or battery charges.

A tail elevated attitude of the watercraft **10** at the water surface **200** is illustrated for example in FIGS. **19-23**. An optional tender craft **500** is also illustrated. The tail elevated attitude of the watercraft **10** at the surface serves to maintain portions of the sphere **30** and passenger compartment **20** under the water surface **200**, thus reducing the size requirements of the ballast tanks **95** and/or **160** by reducing the amount of volume required to be above the surface. This also serves to keep an increased volume of the cabin out of the sun or environmental conditions, reducing sun heating. Likewise, this promotes a safe access point for the tender craft **500** to tether at the rear of the watercraft. Optional rear bumpers **220** and/or front bumpers **610** are provided so as to protect the housing **210** and other elements of the watercraft **10** from contact with the tender craft **500**. Alternatively the angle at surface could be achieved or "trimmed" using an adjustable trim weight **225** that can be moved back to front along the submersible, such as along a track. For example moving the trim weight **225** forward tends to move the center of gravity forward, increasing the angle, and alternatively moving the trim weight **225** towards the rear moves the center of gravity rearward, decreasing the amount of tail up attitude. Likewise, in submerged mode, the trim weight **225** can be moved to adjust the attitude as desired.

Other components of an illustrated embodiment include various thrusters for forward, backward, vertical and lateral (or longitudinal) positioning or motion of the watercraft **10**. Examples of thrusters are lateral thrusters **250**, and vertical thrusters **260**. Operation of the lateral thrusters serves to move the vehicle forward, backwards, left and right, or to turn it laterally. Operation of the vertical thrusters **260** serve to adjust elevation (or amount of submersion), and to adjust roll. Power cables in electrical connection with batteries **185** and control signal wires in electrical connection with steering controls pass through conduits **255**, **265** to their respective thrusters **250**, **260**. Although the batteries are illustrated as being adjacent the surface ballast tanks **95**, they may be located at any desired location on the watercraft **10**. For further steering control, one or more thrusters **250**, **260** may be movably mounted. For example, in surface mode, it may be desired to retain the lateral thrusters **250** in an orientation generally co-planar with the surface plane **200**, and to accomplish this, they may be movably mounted.

Various electronic controls and/or sensors may also be included, such as sonar **270** and USBL for tracking **280**, and DVL **285** for navigation. Bumpers and feet also can be included as desired. For example bottom cushions **290** (such as rubber feet) can be provided to provide a protective contact surface such as for use in transport on a trailer or for bearing the vehicle weight when on a home vessel or port. In the illustrations, the bottom cushions **290** are positioned on the bottom surfaces **212** of the housing **210**, below the lower ballast tanks **95**, batteries **185** and air tanks **180**. Side cushions **300** are also provided on the sides **214** of a lower portion of the housing **210**. Side, forward and rear lights **310**, **320** and **330**, respectively, also may be provided to improve visibility such as in low lighting conditions, or at night. Other lights also may be included, such as adjustable lights **335** for directional lighting. Tie down points **340** are another option, such as for use in securing the watercraft **10** when out of the water. Towing the watercraft by attaching a tow line to the tie down points **340**, towing points **345** or any other structurally suitable portion of the watercraft **10**. In such an embodiment, for example, the watercraft **10** may be towed backwards by attaching a tow line to the tow points **345**. The angle of the watercraft and position of the tow points help lift the watercraft on top of the water surface, as opposed to pulling it under, reducing drag and improving the efficiency and speed of the towing operation.

A tie bar **350** or multiple tie bars **350** may be provide for passengers to hold on to, or to secure the watercraft **10** to a tender craft **500**, such as using a securing cable. In an embodiment, the tie bars **350**, also include securing hook points **360** where the securing cable may be attached or looped. The hoist point (grappling assembly) **125** may be located at any location on the watercraft that can be accessed by a crane or other grappling device. Safety buoy **370** also may be provided at any desired location. In the illustrated embodiment, safety buoy **370** is between the retractable handrails **120**.

Turning now to the interior of the passenger compartment **20**, seating **380** for any number of passengers may be provided. In the illustrated embodiments, a three-seater and five seater version are illustrated. For larger numbers of passengers, more seats are added, and the size of the passenger compartment **20** is increased, such as by adding additional clear sections, or enlarging the sphere **30**. An example of an elongated version **1000** of the watercraft is

shown in FIG. **18**. In the illustrated elongated version **1000**, a transparent hemisphere **1030** is provided in the front, such as an acrylic half sphere. The hemisphere **1030** is connected to a transparent cylinder **1040** by any suitable connector assembly **1050**. An example of a connector assembly would be a metallic pressure vessel ring and seal assembly. The end of the cylinder **1040** opposite the connector assembly **1050** is connected to the access pressure vessel **40** as described herein, such as via a second connector assembly **1060**.

The seats **380** optionally may include designated passenger seats **380** towards the front, and a pilot seat **385** towards the rear, such as for tourism purposes, where the pilot is familiar with the domain. The seats towards the front would have better views outside of the watercraft through the sphere **30** because they are less unobstructed by seats in front of them, such as may promote tourism viewing. Alternatively, the pilot seat **385** may be designated to be toward the front to enable better viewing for navigation in less familiar areas, or for scientific research. Optionally the armrests **382** of the seats **380**, **385** may be lifted or removed so as to promote easier motion by occupants. The seat bases **384** optionally are angled up for rider comfort, and so that they also are comfortable when the vehicle is at the surface **200**, and the vehicle is at an angled tail up attitude. Alternatively, the seat bases are adjustable such that they automatically or manually can change angle depending up on the attitude of the watercraft. Angled seats also can be desirable when underwater, since many occupants may wish to sit with their knees higher than their hips. The angled seats provide a distributed cushioning over the entire upper leg of the occupant, important for longer excursions. This also allows for reducing the size of the passenger compartment **20** due to the more compact nature of the sitting position.

An example of a pilot control panel **390** is shown, although the controls may be located anywhere within the compartment **20** that can be accessed by the operator. A pilot monitor **392** also is illustrated. The pilot monitor **392** may be positioned in any location viewable by an operator, and alternatively may be movably mounted. The monitor may be used to view the exterior such as via front, rear, top, or bottom cameras, for monitoring system parameters such as battery level, compressed air pressure, external conditions sensors, sonar, and so on. An air circulation system **400** also is provided, providing fresh breathable air such as from the air tanks **180**, and supplied via conduits and circulated via fans (illustrated with reference numbers **400**). The ventilation fans **400** also may be positioned so as to keep viewing surfaces free of internal condensation, such as by positioning them to blow air onto the windows and/or interior surface of the sphere **20**.

Other optional elements may be included in the interior of the passenger compartment **20** in order to enhance passenger comfort and ingress/egress movement. For example, step angles are selected in order to make ingress/egress easier in an embodiment in which the surface attitude is angled, as illustrated in FIGS. **21** and **22**. Ladder steps **410** are provided in the access portion, for the occupants of the passenger compartment **20** to climb out via the port assembly **50**. The ladder steps are angled so as to be generally parallel to the surface of the water **200**, and perpendicular to the force of gravity. Cabin floor steps **420** also may be provided so that occupants of the front seats **380** may use them to move from the front to the rear of the compartment **40** at the surface attitude. In operation submerged, the steps **410**, **420** are at an angle not parallel to the surface **200** because the attitude is horizontal, as opposed to generally tail up as at a surface. Optional handrail **430** for holding on ladder steps **410** also may be provided. In an embodiment as illustrated in FIGS. **22** and **23**, one or more of the seats **380**, **385** may be movable so as to clear an exit or entry path within the compartment. In the illustration, seat **385** is folded out of the way.

It should be appreciated that the hatch **60** can be situated at any location on the watercraft **10** that will enable ingress and egress from the watercraft such that water does not flow into the inside of the watercraft **10**, or splashing is reduced. Likewise, the riser **70** optionally may not be included on the watercraft **10**, for example, in one alternate embodiment illustrated in FIGS. **35-39**, the hatch **60** is positioned toward the bottom of the riser **76**/**78**. The riser **70** may be a pressure tight part of the access pressure vessel as shown in FIGS. **1-34**, or the riser **76**/**78** may be a free flooded (non-pressure tight) part that is attached around the hatch via a fluid tight seal or connection. The riser **76** may be a separate component fixed around the hatch as shown in FIGS. **37-39**, or may be a byproduct of a part such as housing **210** illustrated in FIGS. **35-36**, where the riser **78** is created by the shape of the housing **210** around the hatch, providing the housing is connected via a fluid tight seal or connection around the hatch. In addition, optionally a valve assembly **660** is provided. The valve assembly **660** may include various elements, such as for example, a valve alone, or a valve and pump combination, or a one way low pressure check valve with or without a pump. The valve assembly **660** serves to allow for outflow of any water that is in the riser **76**/**78** above the hatch **60** when at surface. It is desirable to remove such water before opening the hatch so that the water does not flow into the interior of the watercraft **10**, when the hatch is opened, and to increase buoyancy at surface, effectively acting as a surface ballast tank **160**. In an embodiment in which the valve assembly **660** includes a one way check valve, the check valve allows the water to drain out of the riser but not return into it. Optionally the valve assembly **660** includes a remotely controlled valve, such as a hydraulically or electronically controlled valve. In this way, the valve may be operable from the interior of the watercraft **10**, and/or the exterior of the watercraft, such as by operators in the tender vessel **500** or by others situated on the outside of the watercraft **10**. Optionally the water could be removed from the riser space above the hatch by a pump included in the valve assembly **660**, remotely operated from the interior of the watercraft and/or the exterior of the watercraft. Benefits of having the hatch at the bottom of the riser include but are not limited to: Reduced displacement of the watercraft; smaller surface buoyancy tanks **95**, **96**, **97** and **160** are required; more efficient manufacture of the access pressure vessel.

In an embodiment illustrated in FIGS. **40-56**, the hatch **60** is positioned on an upper portion of the passenger compartment **20** or sphere **30**. For ingress/egress, the hatch location on the sphere **30** is selected such that it is above the waterline **200** in a surface mode of operation, although it should be acknowledged that the hatch could be below the waterline as long as the riser **76**/**78** extended above the waterline and the water above the hatch was evacuated from the space provided by the riser A riser **76**/**78** may be affixed around the hatch, for example if the hatch is positioned directly on the sphere **30**, or alternatively, the hatch **60** may be positioned at the top of the riser **70**. The riser **70** may be a pressure tight part with the hatch on the top, or the riser **76**/**78** may be a free flooded (non-pressure tight) part that is attached around the hatch via a fluid tight seal or connection. The riser **76** may be a separate component fixed around the hatch or may be a byproduct of a part such as housing **210**, where the riser **78** is created by the shape of the housing **210** around the

hatch, providing the housing is connected via a fluid tight seal or connection around the hatch. Another optional element is a valve **660** or a valve and pump combination **660** or a one way low pressure check valve **660**. The valve **660** serves to allow for outflow of any water that is in the riser **76/78** above the hatch **60** when at surface. It is desirable to remove such water before opening the hatch so that the water does not flow into the interior of the watercraft **10**, when the hatch is opened. An optional Electronics Pressure Vessel **620** may be included to provide extra space for components, and is located in a compartment **625**. Attachment arms **630** fix the electronics pressure vessel to the watercraft **10**. Bulkheads **640** allow for connections to be made between the electronics pressure vessel **620**, battery pods **185**, cabin **30** and equipment such as thrusters **250**,**260**. Displacement provided by the electronics pressure vessel **620** can serve to move the CB backwards towards the electronics pressure vessel compared with just using the sphere **30**.

To help with ingress and egress, the entire passenger compartment **20**, or part of it, may rotate to keep it at a desired angle with the water surface as the watercraft adopts a tail up attitude at surface. The passenger compartment may automatically or manually change its angle depending upon the attitude of the watercraft. This allows for a flat surface for the occupants to step on. An example of such embodiment is shown in FIG. **44**. Alternatively the seat bases **384**, or the entire seats **380** and **385**, are adjustable such that they automatically or manually can change angle depending upon the attitude of the watercraft. An example of such an embodiment is shown in FIG. **45**.

Thus, it is seen that an adjustable attitude underwater watercraft is provided. It should be understood that any of the foregoing configurations and specialized components may be interchangeably used with any of the apparatus or systems of the preceding embodiments. Although illustrative embodiments are described hereinabove, it will be evident to one skilled in the art that various changes and modifications may be made therein without departing from the scope of the disclosure. It is intended in the appended claims to cover all such changes and modifications that fall within the true spirit and scope of the disclosure.

The invention claimed is:

1. An underwater watercraft comprising:

a compartment enclosure defining an interior space;

an ingress/egress port positioned on the enclosed compartment, providing access to the interior space from outside the enclosed compartment; and

an attitude adjustment system adapted to move the watercraft in at least two operational modes including

a submerged mode defining a submerged mode center of buoyancy; and,

a surface mode defining a surface mode center of buoyancy, the surface mode center of buoyancy being further to the rear of the watercraft in relation to the submerged mode center of buoyancy.

2. The underwater watercraft of claim **1** wherein:

the ingress/egress port defines an opening, having an opening plane; and

in the surface mode of operation, the opening plane is substantially perpendicular to a direction of gravity.

3. The underwater watercraft of claim **1** further comprising an elongated hatch assembly, the direction of elongation of the hatch assembly being generally parallel to the direction of gravitational force at the surface attitude of the watercraft and angled in relation to the direction of gravitational force at the submerged attitude of the watercraft.

4. The underwater watercraft of claim **1** wherein the enclosed compartment includes a first portion and access pressure vessel attached to the first portion, the access pressure vessel defining an access pressure vessel interior space, the access pressure vessel interior space coextensive with the interior space of the first portion.

5. The underwater watercraft of claim **1**, wherein the attitude adjustment system includes at least one of a ballast tank or a moveable weight.

6. The underwater watercraft of claim **1** wherein a buoyant force applied by evacuation of the ballast tanks is centered at a point anterior to a location of a center of gravity of the watercraft when in the submerged mode.

7. The underwater watercraft of claim **1** wherein the ingress/egress port includes a hatch assembly, the hatch assembly including:

an openable hatch cover positioned on the compartment and sealing the ingress/egress port in a closed position; and

a riser extending from the compartment adjacent the openable hatch cover.

8. The underwater watercraft of claim **1** wherein the ingress/egress port, includes a hatch assembly, the hatch assembly including:

a hinged hatch cover spatially separated from the compartment;

a riser positioned between the compartment and the hatch cover;

a hinge assembly hingedly connecting the hatch cover to the riser.

9. The underwater watercraft of claim **8**, wherein the riser includes a skirt making the riser extendible from at least a first length and a second length.

10. The underwater watercraft of claim **7** wherein the riser is mounted at an angle relative to a surface plane in the surface mode.

11. The underwater watercraft of claim **8** wherein the riser is mounted at an angle relative to a surface plane in the surface mode.

12. The underwater watercraft of claim **1** further comprising a tow point oriented such that in the surface mode a tow line is attachable to the tow point.

13. The underwater watercraft of claim **4** wherein the ingress/egress port includes a hatch assembly, the hatch assembly including:

a hinged hatch cover spatially separated from the compartment;

a riser positioned between the compartment and the hatch cover;

a hinge assembly hingedly connecting the hatch cover to the riser.

14. The underwater watercraft of claim **13**, wherein the riser includes a skirt making the riser extendible from at least a first length and a second length.

15. The underwater watercraft of claim **1**, wherein the attitude adjustment system includes:

one or more surface ballast tank mounted above a horizontal midline of the compartment; and/or

one or more bottom ballast tanks mounted below a horizontal midline of the compartment.

16. The underwater watercraft of claim **4** wherein the ingress/egress port includes a hatch assembly, the hatch assembly including:

an openable hatch cover positioned on compartment and sealing the ingress/egress port in a closed position; and

a riser extending from the compartment adjacent the openable hatch cover.

17. The underwater watercraft of claim 16 wherein the riser is mounted at an angle relative to a surface plane in the surface mode.

18. The underwater watercraft of claim 17, wherein the attitude adjustment system includes:

one or more surface ballast tank mounted above a horizontal midline of the compartment; and/or

one or more bottom ballast tanks mounted below a horizontal midline of the compartment.

19. An underwater watercraft comprising:

an enclosed compartment defining an interior space;

an ingress/egress port positioned on the enclosed compartment, providing access to the interior space from outside the enclosed compartment;

a plurality of seats arranged within the compartment, the each of the plurality of seats including a seat base, the seat base angled up in both a surface mode and a submerged mode and optionally at least one of the seats is movably mounted within the compartment and can be moved for viewing or boarding, and,

an attitude adjustment system adapted to move the watercraft between the surface mode and the submerged mode wherein the surface mode defines a surface mode center of buoyancy and the submerged mode defines a submerged mode center of buoyancy, the surface mode center of buoyancy being further to the rear of the watercraft in relation to the submerged mode center of buoyancy.

20. The underwater watercraft of claim 1, wherein the attitude adjustment system includes:

one or more surface ballast tank mounted above a horizontal midline of the compartment; and/or

one or more bottom ballast tanks mounted below a horizontal midline of the compartment.

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